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Yours truly
Isaac D. Smead

VENTILATION

AND

WARMING OF BUILDINGS,

UPON THE PRINCIPLES AS DESIGNED AND PATENTED

BY

ISAAC D. SMEAD,

Now owned and controlled under 13 patents)

J. C. Northcott,

BY

Successor to

SMEAD & NORTHCOTT,
ELMIRA, NEW YORK.

ISAAC D. SMEAD & CO.,
TOLEDO, CINCINNATI, KANSAS CITY AND WASHINGTON.

SMEAD, WILLS & CO.,
PHILADELPHIA, PA.

SMEAD, DOWD & CO.,
TORONTO, ONT.

SMEAD WARMING AND VENTILATING CO.,
BOSTON, MASS.

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T. C. Northcott

Successor to

SMEAD & NORTHCOTT,

ELMIRA, NEW YORK.

ISAAC D. SMEAD. THEODORE C. NORTHCOTT.

February 11, 1889.

HON. ISAAC D. SMEAD,
Toledo, Ohio.

Dear Sir :

The undersigned, your associates in business, respectfully urge upon your consideration the unanimous and earnest desire of all connected with each of the Smead offices which we represent that you permit the publication of your portrait as a frontispiece for the new book which you are now preparing. You are both the *founder* and the *present inspiration* of the business in which we are engaged, and wherever we introduce the Smead system we hear expressed the desire to "see Mr. Smead." From some correspondence with you upon this subject we are aware that it will not be in the line of your inclinations to grant our request, but it seems to us so appropriate as to become almost imperative. We trust you will, therefore, lay aside your personal preferences and permit the publication of the picture.

Respectfully yours,

SMEAD & NORTHCOTT, Elmira.
SMEAD, WILLS & CO., Philadelphia.
SMEAD, DOWD & CO., Toronto, Ontario.
SMEAD WARMING & VENTILATING CO., Boston.
ISAAC D. SMEAD & CO., Kansas City.

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WARMING

AND

VENTILATION OF BUILDINGS.

Dr. ——— : Good morning, Mr. Smead; I am glad to find you in your office and alone. I am told that you are the largest manufacturer of warming and ventilating apparatus in America; and, being very much interested in the subject, I have called to get such information as you may feel disposed to give. I also propose to examine the operation of your apparatus in some of our public school buildings. I have been invited to read a paper at the meeting of the State Sanitary Association, and desire to state the truth, as near as I am able to learn what it is.

Mr. Smead : I am glad to see you, doctor, and if you are disposed to be influenced by *facts* rather than by *theories*, and will devote the necessary time to a full investigation, and then state your conclusions in a *positive, definite* manner, I will devote an hour or two a day to the subject, and when we are through I have no fear concerning the opinion you will hold.

Dr. ——— : Are you the largest manufacturer of warming and ventilating apparatus in America?

Mr. Smead : For large buildings, yes. The firms of

Isaac D. Smead & Co., Toledo, Cincinnati, Washington and Kansas City,
Smead, Wills & Co., Philadelphia,
Smead & Northcott, Elmira,
Smead, Dowd & Co., Toronto,
Smead Warming & Ventilating Co., Boston,

of which I am the "Smead," do more work in our line than any firms in either America or Europe.

Dr. ——— : How long have you been engaged in the business?

Mr. Smead : Since boyhood; over twenty years. The experience of those associated with me varies from five to seventeen years.

Dr. ——— : Tell me about the early history of the Smead heating and ventilating business.

Mr. Smead : The story is too long. The road I have traveled has been rough, with thorns all along the path, until during the past seven or eight years, and there are more now than I wish there were. There would be less if people would think more.

Dr. ——— : Who commenced the business in which you are now engaged?

Mr. Smead : In 1862 Hon. Henry Ruttan, of Canada, published a large book upon the subject of warming and ventilating, illustrating some of his theories by diagrams, etc. In 1866 this book, by accident, fell into the hands of some gentlemen in Illinois who were pleased with the theories advanced by Mr. Ruttan; they purchased his patent for the United States. I was a boy employed about their office.

Dr. ——— : Did Mr. Ruttan manufacture a heating apparatus?

Mr. Smead : No, nor did he ever apply his theories on ventilation to a building containing more than one room. *He simply advanced a theory.* He was about eighty years old when he wrote his book.

Dr. ——— : What were some of his theories?

Mr. Smead : Briefly, that the point of exit for foul and cold air from a room should be *at* or *below* the floor level, instead of, as then supposed, at the *top* of the room; and that a *large volume* of *moderately warmed* air should be supplied instead of a *small* quantity of *hot* air.

Dr. ——— : You surprise me! Do I understand you to say that previous to the establishment of your business people attempted to ventilate their rooms at the ceiling?

Mr. Smead : Yes, and there are many now who do not know but that is the proper locality for foul air exits. Scarcely a week passes that architects do not lay before me plans with no other method represented.

Dr. ——— : But that would render uniform warming impossible, as all the warmest air of a room is at the top.

Mr. Smead : So it would except by radiation as from either a steam coil or a stove; and furthermore, with the stove or steam coil ventilation is not possible, as they only warm and re-warm the air in the room.

Dr. ——— : What did your employers do with Mr. Ruttan's patents and theories?

Mr. Smead : They commenced to advertise "the correct system of ventilation" and to argue for the proper construction of buildings.

Dr. ——— : What do you mean by "proper construction of buildings?"

Mr. Smead : As buildings were then constructed only smoke-flues were provided. Occasionally some so-called "ventilators," made of either wood or sheet iron, were scattered about the roof, wherever most convenient for the architect's draftsman or the contractor to locate them. My employers (Messrs. Wm. A. Pennell & Co., of Normal, Ill.), argued in favor of the construction of a large ventilating flue or stack extending entirely through the building from the basement, and also the construction of large cold and warm-air conduits. They were entirely inexperienced in the work, none of the three being practical builders; one was a retired merchant, the other an iron manufacturer, the third a visionary, impractical theorist.

Dr. ——— : Were many buildings constructed as you describe?

Mr. Smead : Yes, for notwithstanding the fact that the system was assailed, ridiculed and condemned by all those interested in the manufacture of stoves, hot-air furnaces and steam-heating apparatus, there was a pressing demand, and a great many were people anxious to secure a system of ventilation, more especially those familiar with the condition of school buildings where children were being boxed-in six hours per day.

Dr. ——— : Was the system successful?

Mr. Smead : Yes, as to ventilation; but as to heating, a total failure.

Dr. ——— : Why a failure?

Mr. Smead : Principally because one very important point had been entirely overlooked by all interested parties.

Dr. ——— : To what do you refer?

Mr. Smead : A heating apparatus. Our plans, as I have before stated, called for "large cold-air ducts" for supply, "large warm-air flues," and a "large ventilating stack" or chimney for exhaust. Buildings had been constructed wherein these were provided, and "Tom, Dick and Harry" had furnished the heating apparatus ("hot-air furnaces"); they were insufficient to warm the volume of air required, and as a result either the heating apparatus or the ventilation must fail. My employers had guaranteed both, and were in a very serious position. Those who had opposed the system were happy, friends discouraged, and customers mad. It would amuse you to read our correspondence during the winter of '67 and '68; it does me *now* (1889), it did not *then!*

Dr. ——— : What was done?

Mr. Smead : The capacity of cold-air ducts and ventilating flues were reduced, customers kept as quiet as possible by promises of a new heating apparatus *as soon as one could be invented and manufactured.*

Dr. ——— : An encouraging outlook!

Mr. Smead : Not very to those of us familiar with the entire situation; but, with a courage born of necessity, work was commenced; and as we were in about the position of those who first discovered the force in steam and wanted an apparatus that would enable them to boil water rapidly, and who invented the tubular boiler, we took it as a guide, and as it could be completed more quickly in wrought than cast iron we made the first air-warmer of wrought iron.

Dr. ——— : Was it "a go"?

Mr. Smead : Unfortunately it was. The natural fuel in the West was soft coal : but by chance this, our first air-warmer, was sent into a section of the country where wood was the fuel used. The apparatus was placed in position under very favorable circumstances, and was found to warm three or four times as much air with the same fuel as any other.

Dr. ——— : I suppose you were then very happy.

Mr. Smead : The visionary member of the firm was ; the other two were in doubt, as they raised the question of *durability*. I was a "boy" around the office and shops, and was not consulted, even if I had an opinion. Some *scientific* fellow in France published a book about that time, claiming that wrought iron was the best material from which to construct warming apparatus, and following his advice nearly a hundred were manufactured, at a cost of many thousands of dollars. They were scattered over the Western States, and as soon as cold weather came, and especially where soft coal was used, we soon learned that, although the Frenchman's ideas might be very good for the climate of France, for America we must have some other material than wrought iron.

Dr. ——— : Why?

Mr. Smead : Because of our extremely cold weather. The wrought iron could not meet the demand, especially when soft coal was the fuel used. Many of those furnaces did not last a month, and nearly all were used up before spring.

Dr. ——— : What did you do then?

Mr. Smead : Wished we had our money back and had never heard of Mr. Ruttan or his system of ventilation.

Dr. ——— : What did your customers do?

Mr. Smead : Some of them *swore!* Some abandoned us, put up stoves or introduced steam : for you must remember that any building can be *warmed* with steam if the boiler is large enough and the pipes are properly placed. Others, still anxious to secure ventilation, and having confidence in the principles advanced by us, even if apparatus was imperfect, urged us to go on and try again. This was done ; the mechanical member of the firm commenced to make patterns for a cast-iron air-warmer, following the same principles as before, namely, the tubular boiler. Here is one of the old circulars containing a cut of the second furnace made by Messrs. Pennell & Co. I have but three of these little books, and value them as relics of the past.

Dr. ——— : That don't look much like the Smead air-warmer of 1888.

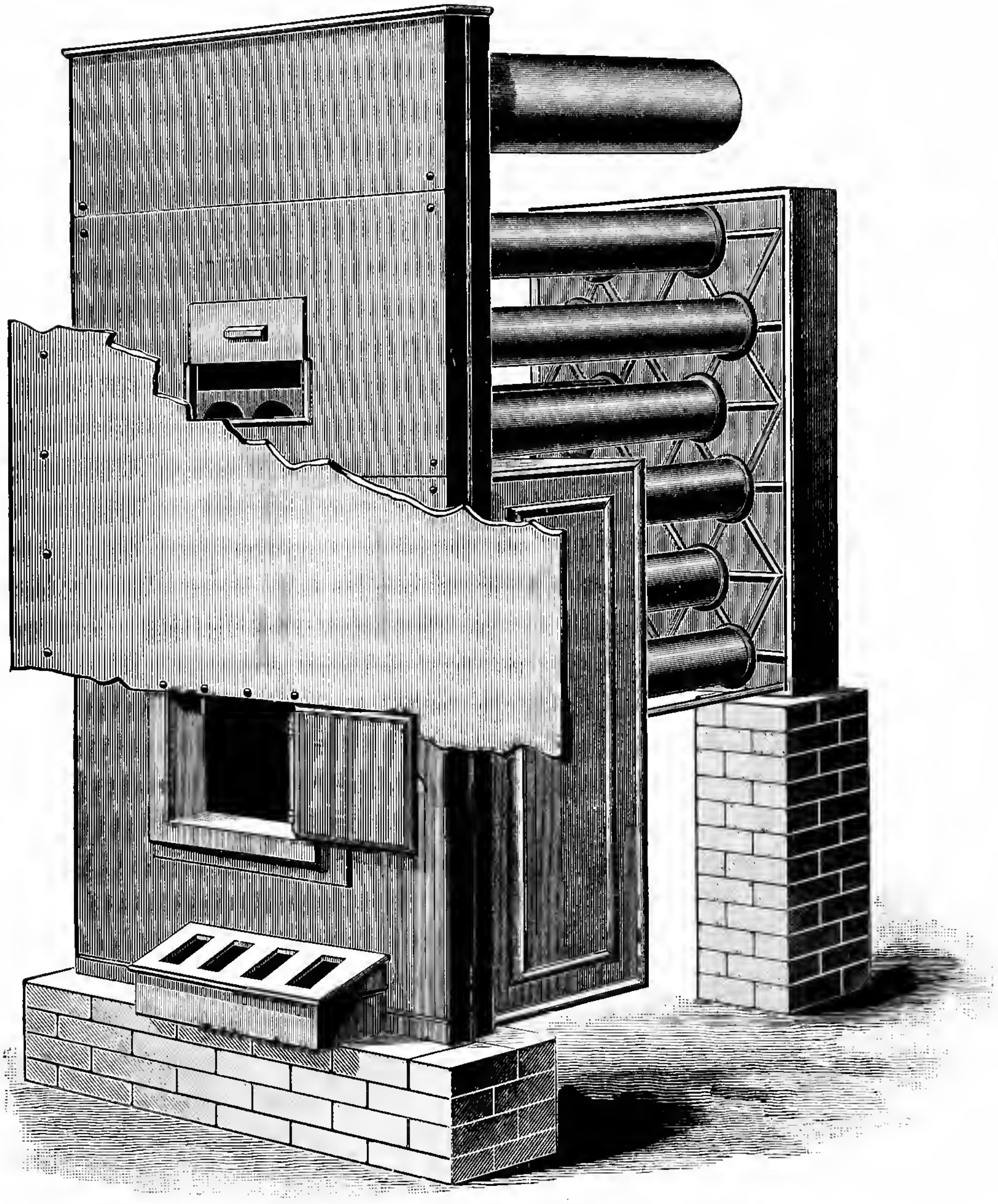
Mr. Smead : Nor does the locomotive of today resemble the one made forty years ago.

Dr. ——— : Was the apparatus you represent here a success? (See cut page 10.)

Mr. Smead : In some respects, yes ; but generally, no. It was more durable than the other, and did not get tired quite so quickly as did those made of sheet iron ; but, owing to the fact that we were pioneers in the use of soft coal, we had obstacles to overcome that others had not struggled with. We could not *copy* as other manufacturers did, for we were on a new track. Our great trouble was to prevent the annoyance from smoke and soot ; this had not been accomplished in the new furnace, and customers were but little better pleased than before, there being in their minds but little choice between being frozen or smoked. Hot-air furnace manufacturers, steam-fitters and stove manufacturers were about the only ones thoroughly pleased with the second attempt to get into successful operation the apparatus and system that should provide both warmth and ventilation.

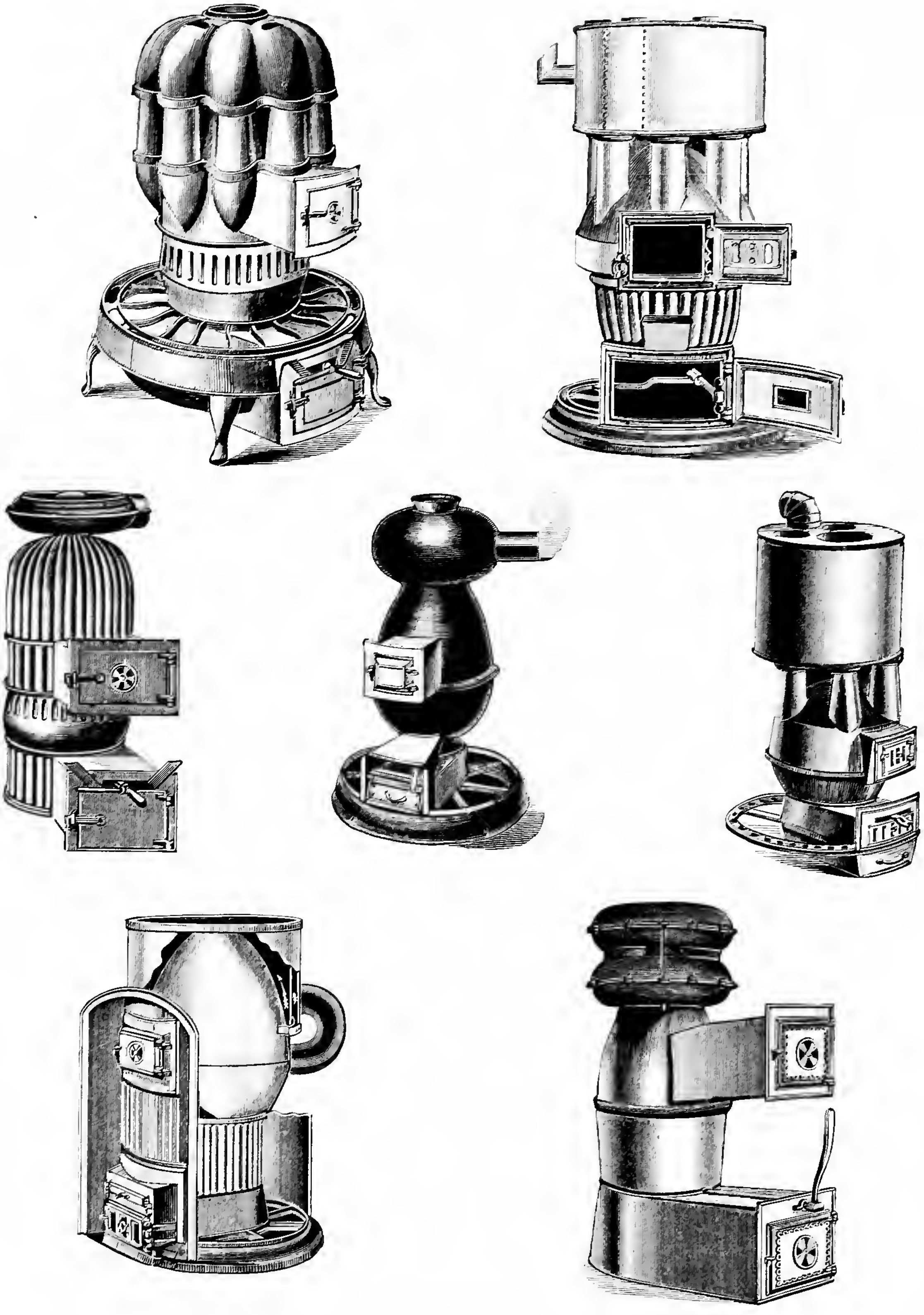
Dr. ——— : You speak of other manufacturers "copying." To what do you refer?

Mr. Smead : For many years there have been manufactured "hot-air furnaces," generally made by stove makers and sold by stove dealers. Just examine these cuts (see pages 11 and 12) and you will notice that they are all about the same — a fire pot, a drum and a smoke-pipe. Each practically a copy of the other, differing only in name : one calls his the "Fire King," another the



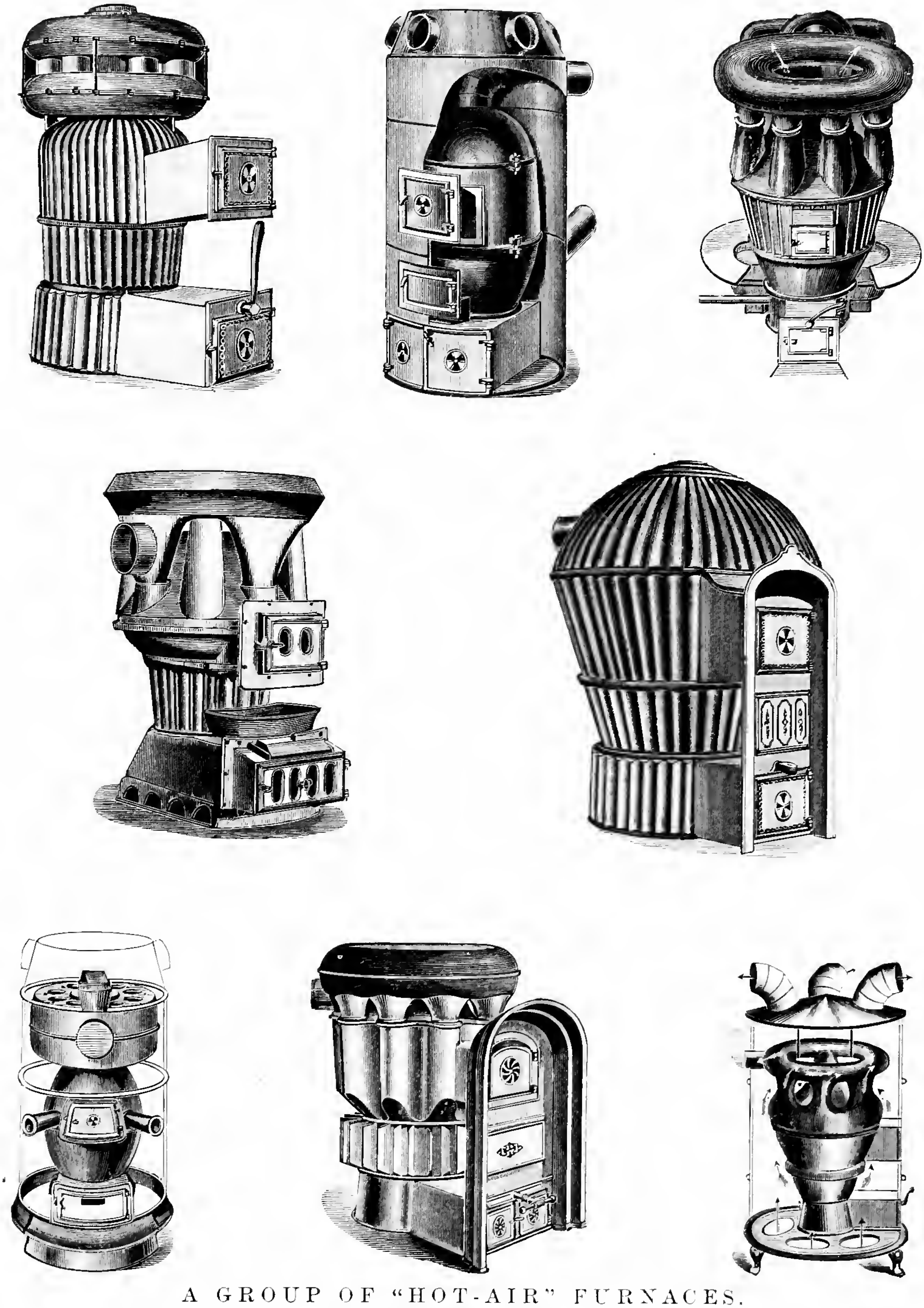
THE AIR-WARMER AS MANUFACTURED IN 1867.

"Prairie Queen"; "Commander" and "Peacemaker" are also represented, but so far as heating capacity is concerned, one is but little, if any, better than the others. They have a small amount of heating surface, and that surface is very hot. Their use in connection with ventilation had demonstrated the fact that *something new* must be provided, and although nearly three years had passed, we had failed to meet the demand; for, as I have said, we could not copy or steal the ideas of others, as is done by most manufacturers. Before the use of steam there was never any boiling apparatus except a kettle; before the people learned of the necessity for ventilation they were satisfied with "heat," no matter how it was obtained and regardless of the quality of the air.



A GROUP OF "HOT-AIR" FURNACES.

(See pages 9 and 10.)



A GROUP OF "HOT-AIR" FURNACES.

(See pages 9 and 10.)

Dr. ——— : I understand that you were trying to get an apparatus that had a larger amount of fire surface than any previously manufactured.

Mr. Smead : Yes, that is exactly what we were trying to do.

Dr. ——— : How did you accomplish it ?

Mr. Smead : Instead of the fire pot of that day, we made a long fire box, the fire box alone having more fire surface than the ordinary furnace. At the rear of the fire box were some short pipes, through which the smoke and flame passed to a large chamber, thence forward to a front chamber, then back again to the rear. Please examine the cuts representing the "hot-air furnaces," and you will notice that the distance from the grate to the point where smoke goes into smoke-pipe is very short — only about five feet.

Dr. ——— : This must make a very hot smoke-pipe, and result in a great waste of fuel.

Mr. Smead : So it does, and that is one of the reasons why people complain because "furnaces consume so much fuel."

Dr. ——— : You say "one of the reasons" : give me another reason.

Mr. Smead : Another reason is because they are generally set in position by stove dealers, who know little or nothing about heating and the question of ventilation. They attempt to force the hot air into rooms already full of cold air, without making any provision for the exit of the cold air already in the room. Architects are more at fault than the owners of the buildings for constructing them in the manner they are generally built. But let us go back to the question of the proper construction of an air-warmer ; we will take up the subject of engineering and ventilation at some other interview. Now you will notice by examining this cut that this air-warmer is not built upon the plan of the hot-air furnace at all. (See cut page 14.)

Dr. ——— : How large is the furnace you represent here ?

Mr. Smead : The cut represents an air-warmer ten feet long, six feet high and three feet six inches wide.

Dr. ——— : It would therefore seem that you hold on to the smoke and other products of combustion for a distance of about forty feet before they are permitted to go to the chimney ?

Mr. Smead : Yes, and at the same time we present to the volume of cold air to be warmed a very large amount of fire surface heated to a much less degree than the red-hot fire pot and dome of the round furnace represented by the other cuts I showed you.

Dr. ——— : Well, what was the matter with this furnace, or "air-warmer," as I notice you call it ?

Mr. Smead : I will first answer your question by asking you another. Who was there who could tell how large to make the fire box, how much grate surface to use, how large to make the pipes at the rear, the proper size of the long ones or the large one that was to connect with smoke-flue ? All the libraries of the world contained but little information upon the subject : all heating appliances manufactured at that time were for use of hard coal and heating very hot a small amount of air. We were working in another direction and had no guide, and only by a *guess* at first, and experimenting with those made and in use did we learn the answer to your question. You ask "what was the matter ?" There was something wrong with almost every casting. The "rules" given by "scientists" which we had followed were found to be valuable only on paper ; those who had always opposed, ridiculed both the system of ventilation and the apparatus ; disgusted customers "kicked," thousands and thousands of dollars had been lost, my employers were discouraged and the present reputation and condition of the business seemed a long distance away.

Dr. ——— : The evolution of the Smead air-warmer makes a very interesting chapter.

Mr. Smead : Those were indeed days of anxiety. Come in again tomorrow, doctor, and I will give you another chapter. There have been a good many in the past twenty years : the one given you only comes down to 1872. Tomorrow I will, as briefly as possible, outline the history of the next five years

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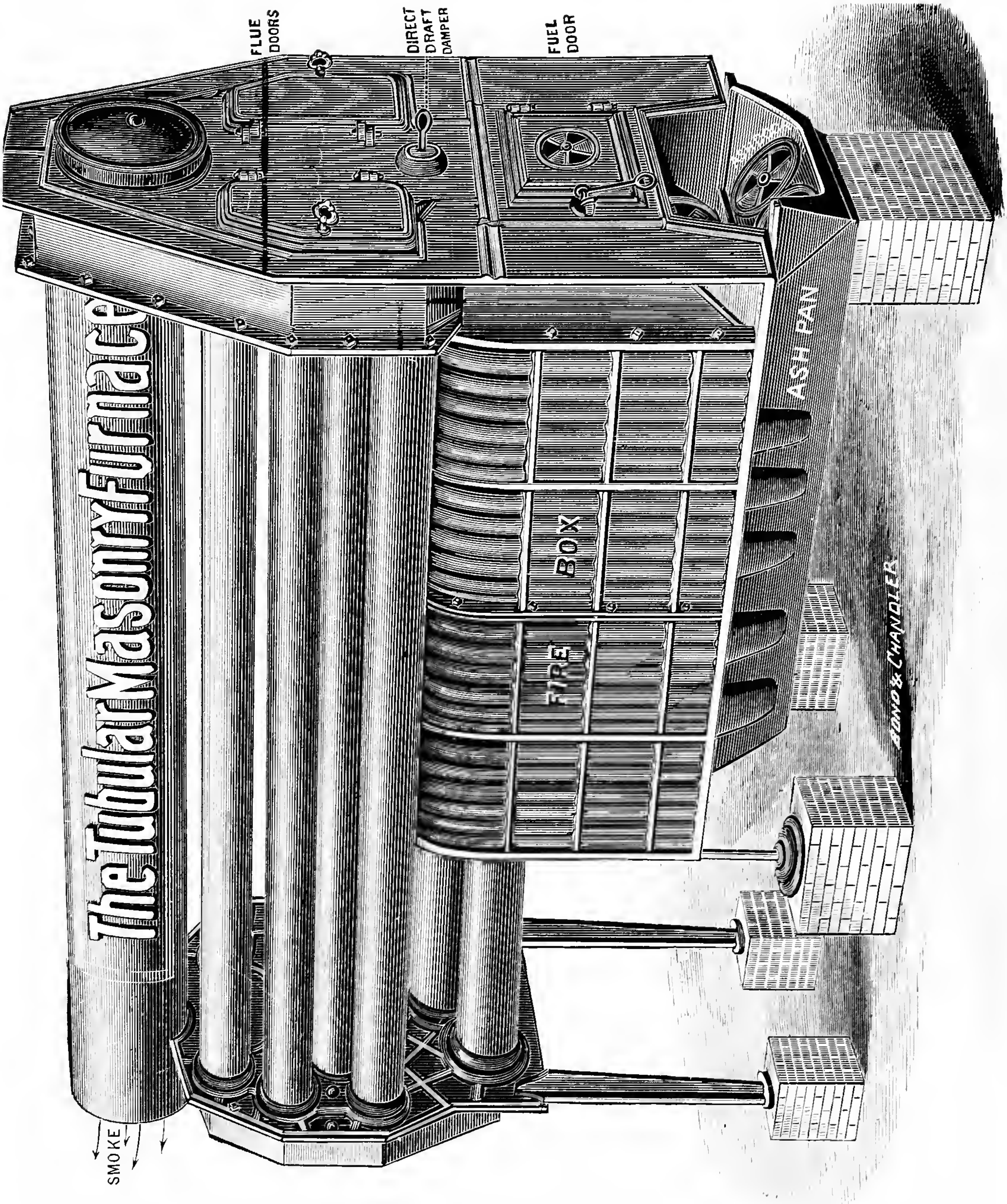

The RUTTAN TUBULAR CAST-IRON FURNACE, as manufactured previous to 1885. (See page 13.)

Mr. Smead : Doctor, I told you yesterday that I would give you some more "history" when you next came in. I do this because it is true that the story of the business you see conducted here and at the other offices (Elmira, Philadelphia, Toronto, Kansas City, Boston, Cincinnati and Washington) is a correct history of the commencement and advancement of the science of ventilation as it is now developed, understood and applied. A thorough knowledge of what has been done, of experiments that have been made, is sometimes necessary to prevent establishment of false theories, and may keep you from going off on a track that will lead only to embarrassment and failure. I am pleased to have this conversation with you for several reasons ; principally because it was from men in your profession that we first received our encouragement to go on, notwithstanding the fact that advancement of the science of ventilation was contrary to the pecuniary interests of the medical profession. Take, for instance, the situation of this city ; the introduction of our apparatus in the twenty-four school buildings, whereby over nine thousand school children are permitted to sit in rooms from which every cubic foot of air is removed every twelve minutes, has resulted in a reduction of the revenue of the doctors among school children fully seventy-five per cent ; and yet it is from the doctors that I receive the strongest recommendations and most urgent requests that we extend our work. I am convinced that your profession either do not care for money, or you are the most unselfish of men. Where did we stop yesterday ?

Dr. ——— : Away back in the anxious days of 1872.

Mr. Smead : Early in 1872 some of the firm retired, a new company was organized, and we commenced for the third time to manufacture new apparatus. The active members were our superintendent, Mr. S. D. Fisher (now of Smead, Dowd & Co., Toronto, Ont.), and myself as the secretary of the new company. From that date to 1877 we expended many thousands of dollars in patterns and machinery, and our improved apparatus was introduced into hundreds of buildings throughout the West ; for five years we did a large amount of work, some of which was done with considerable credit to ourselves and great satisfaction to our customers. Not a pattern that was in use in 1872 was used in 1877, and success seemed assured. More than $50,000 had been expended in improvements, and but for an unfortunate investment in poor iron, which caused a suspension, we should have been contented. The business could not at that stage be permanently stopped ; a new company was organized and the offices moved to Chicago. Mr. Fisher was still continued as superintendent. I was made the president, and filled the position as well as I could with all the embarrassments incident to that of head officer of a stock company with limited capital and total lack of harmony among its stockholders and officers. In January, 1882, I resigned my position and came to Toledo, taking as my territory in which to do business that portion of the United States lying north of the Ohio river and east of Illinois.* The other portion of the United States was still retained by my old associates. During the five years previous to 1882 but little advancement had been made either in heating apparatus or in application of the system of construction, due mainly to the fact that "Too many cooks spoil the broth." There were too many to please, and too many with a right to express and enforce their opinions. I had been with the business for many years, and chafed under the restraint of no progress ; but at last, fifteen years after its commencement, I was in a position to push it in my own way, and if I pushed it to failure it was no one's business but my own.

Dr. ——— : What was the first thing you did ?

Mr. Smead : Immediately after I established my office I employed a draftsman, and decided that no apparatus should be sold or set except a plan showing the proper construction of the building was made, and this plan adopted by the owner of the building, and the building constructed in accordance therewith.

Dr. ——— : Was this an innovation upon the past methods ?

Mr. Smead : Yes ; up to that time I had never known such a department in connection with any office where heating apparatus was sold. We did before that sometimes make sketches, but generally they were to express to our superintendents our ideas of the way the apparatus should be made to conform to the plans drawn by an architect, who may or may not have designed some plan of supply and exhaust. I took the position that my great experience—a hundred times greater experience than any architect had ever had—was a better guide for the owners than the *views*, *theories*, *ideas*, *guesses*, or whatever you may call them, of architects, many of whom had never erected a dozen buildings.*

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*The Kansas City office is doing business only in Missouri, Kansas and Nebraska — established October, 1888.

Dr. ——— : But some of them claim to have "made the study of ventilation a specialty."

Mr. Smead : Your remark reminds me of the United States Senator who stated that he "now fully understood the subject of finance," for he "had been studying the subject for the *last three days*."

Dr. ——— : Was your method approved by the architects and their clients ?

Mr. Smead : Some of the architects did as they always had done, namely, claim to know *all about everything* — heating, ventilation, light, acoustics, stone-work, brick-work, carpenter-work construction of all kinds, art, architecture ; in fact, all that makes life worth living. Others, and they (I have since learned) were the most prominent ones in the state, said, "We are glad you are willing to assume that portion of the work, and to guarantee success ; it has been the one subject that has given us the most trouble." I shall never forget the honest, hearty grip of one architect who, when he read my card, extended his hand and said, "I am glad to see you ; I know you will succeed if you understand the business. I have built as many public buildings as any architect in Ohio ; I have tried everything — steam, hot water and furnaces — and among all my buildings there is not one properly warmed or thoroughly ventilated."

Dr. ——— : Were your plans approved by owners of buildings ?

Mr. Smead : Yes, as soon as they fully understood the question. The Board of Education of Toledo had just ordered the erection of a six-room addition to one of their buildings, and the first plan I designed differed so much from methods pursued before that it was only after careful investigation that they were induced to adopt it.

Dr. ——— : What apparatus had they been using ?

Mr. Smead : All kinds ; mostly "hot-air furnaces," although they had steam apparatus in some buildings. They required new apparatus in the six old rooms. The agents for the old hot-air furnace claimed they could do better work than I could (they often so claim), and the Board purchased theirs for the old portion of the building and mine for the new.

Dr. ——— : What was the result ?

Mr. Smead : It cost $236 less for fuel to warm six rooms with my apparatus than to warm the same number of rooms with the other apparatus, on the other side of the hall, during the winter of 1882 and 1883. They used a less number of tons of *soft coal* in our air-warmer than they did tons of *hard coal* in the hot-air furnace.

Dr. ——— : How about the ventilation ?

Mr. Smead : The air-meter said that on our side the air in each schoolroom was changed every nine minutes, while on the other side there was little or no ventilation.

Dr. ——— : That was in 1882 ; how many school buildings are there in Toledo now containing your apparatus ?

Mr. Smead : *Every public school building in the city* — twenty-four in all.

Dr. ——— : What was done with the old apparatus ?

Mr. Smead : It was taken out and sold for old iron.

Dr. ——— : What was the total saving in fuel ?

Mr. Smead : At prices they were paying then the saving in fuel was between $8,000 and $9,000 per annum. They use natural gas now, and prices given by the gas company are based on cost of warming with my apparatus. The small cost of heating such large buildings was a great surprise to the superintendent of the gas company, and I am inclined to think something of a disappointment, as his previous calculations were based on cost in other cities.

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* Moreover, the architects themselves are now finding it expedient to adopt the same method of subdivision in their work which has become necessary not only in many of the practical arts but even in the legal professions, namely, either to employ special experts in the different departments, or else to organize firms in which one should be the artist, another the builder, another the engineer. *Modern requirements make specialization necessary, and there are few indeed who can qualify themselves for all the requirements of almost any profession.—Edward Atkinson in Century.*

Dr. ——— : Did the Toledo Board reconstruct their buildings to introduce your system?

Mr. Smead : Yes, in all old buildings they built the necessary smoke, warm air and ventilating flues. The apparatus and expense of introduction in one building cost over $13,000.

Dr. ——— : You refer to the High School building?

Mr. Smead : Yes; all new ones constructed since the first test of my apparatus have been built in accordance with plans designed by me. By plans I refer only to plans for warming and ventilating, not to other portions of the building. I do not care whether the building in design or finish is modern or ancient, or a combination of both, whether it be one story or ten, whether it contains one room or a hundred, whether the owner be Jew or Gentile; I simply take the plans as they are drawn by the architect, make a plan showing proper size and location of smoke, ventilating and warm air flues, size and location of heating apparatus, and ask its adoption, and guarantee success if plan is followed.

Dr. ——— : How do you know they will be followed if adopted?

Mr. Smead : The owner must contract with me for the apparatus, which I agree to set in position, ready for use, and to furnish a superintendent to see the building frequently during its construction; and if plans are not being followed he will insist upon work being properly done or stop the work.

Dr. ——— : Does he often have trouble?

Mr. Smead : Not with the customer, but sometimes with a rascally contractor or "smart Aleck" of an architect, who either wants to cover some error of his own or aid the builder to cheat the owner.

There is one point on which we have more trouble than on all others combined. Nine-tenths of all complaints that come to us come because of this one thing.

Dr. ——— : What is that?

Mr. Smead : Deficient height of smoke and ventilating flues. I insist that they are made *for use as such*, and should be constructed to a height that would prevent their operation being interfered with by other portions of the building, the roof, towers, cupolas, etc.

Dr. ——— : I should not suppose there would be any argument on that question.

Mr. Smead : You would change your mind if you should work for us for a month. Why, only the other day I called the attention of an architect to the fact that as flues were represented on his plans they could not "draw" when the wind came from the west. (See cuts page 18.)

Dr. ——— : What did he say?

Mr. Smead : Called my attention to his "beautiful design for stone steps to main entrance," dismissing the chimney question with the remark that "contract was already awarded and could not be changed!"

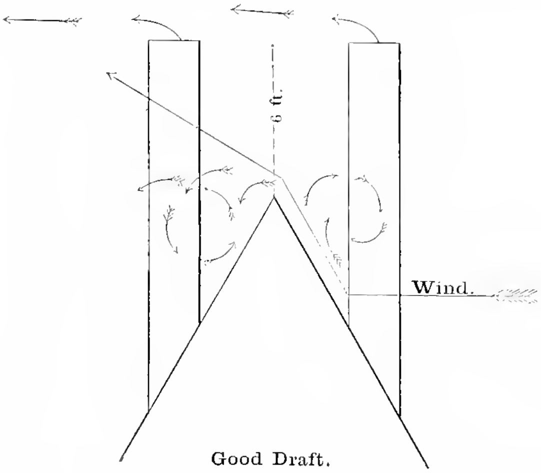
Dr. ——— : What did you do?

Mr. Smead : Called the attention of the owner to the error, and before the building is finished those flues will go to a point not an inch less than eight feet above the highest point of the roof. If the change is not made that building, costing over $60,000, will not be properly ventilated, and the smoke from the heating apparatus will puff out into the face of the fireman when he puts in fuel. When the January wind blows from the north or west is about the time that we want a heating apparatus in successful operation.

Dr. ——— : You speak of introducing your apparatus into twenty-four school buildings in Toledo; have you had equal success in other cities?

Mr. Smead : Yes. In 1883 I furnished apparatus for two school buildings in Washington, D. C.; there are now, in 1889, thirty-three school buildings there, warmed and ventilated by my apparatus. In 1883 I furnished for one school building in Columbus, Ohio; there are now eleven school buildings there containing our apparatus. In 1883 I furnished for one school building in Detroit, and last year for ten more; one for Cleveland Board in 1886, five in 1887; and I could name scores of other cities where the same results have been obtained. I have furnished apparatus for more than one thousand buildings during the last few years.

Dr. ——— : Do you meet with much opposition?



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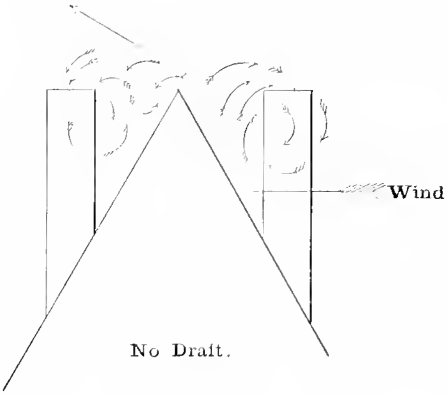
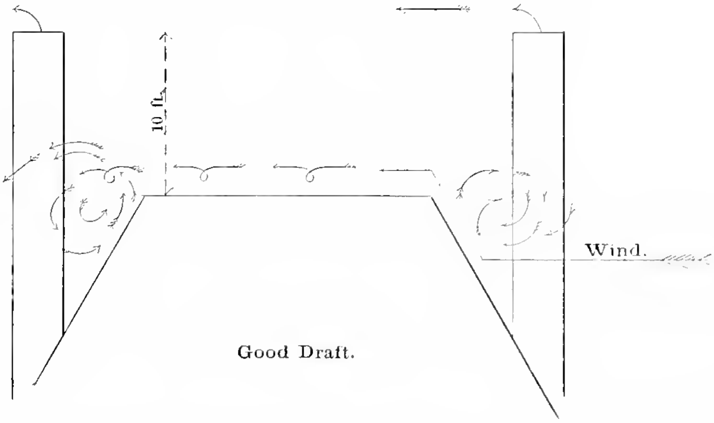


No Draft.

Mr. Smead : Yes, and especially in the larger cities.

Dr. ——— : From whom?

Mr. Smead : Steamfitters, plumbers, dealers in hot-air furnaces made in stove foundries. These parties, aided by their political friends, worry us sometimes.



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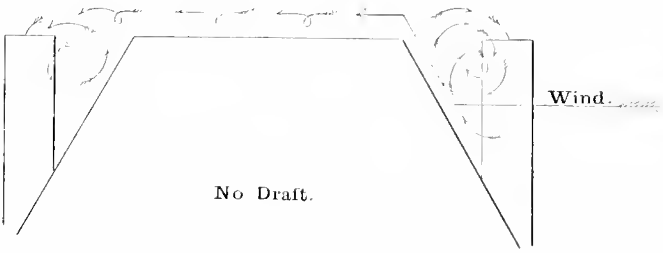

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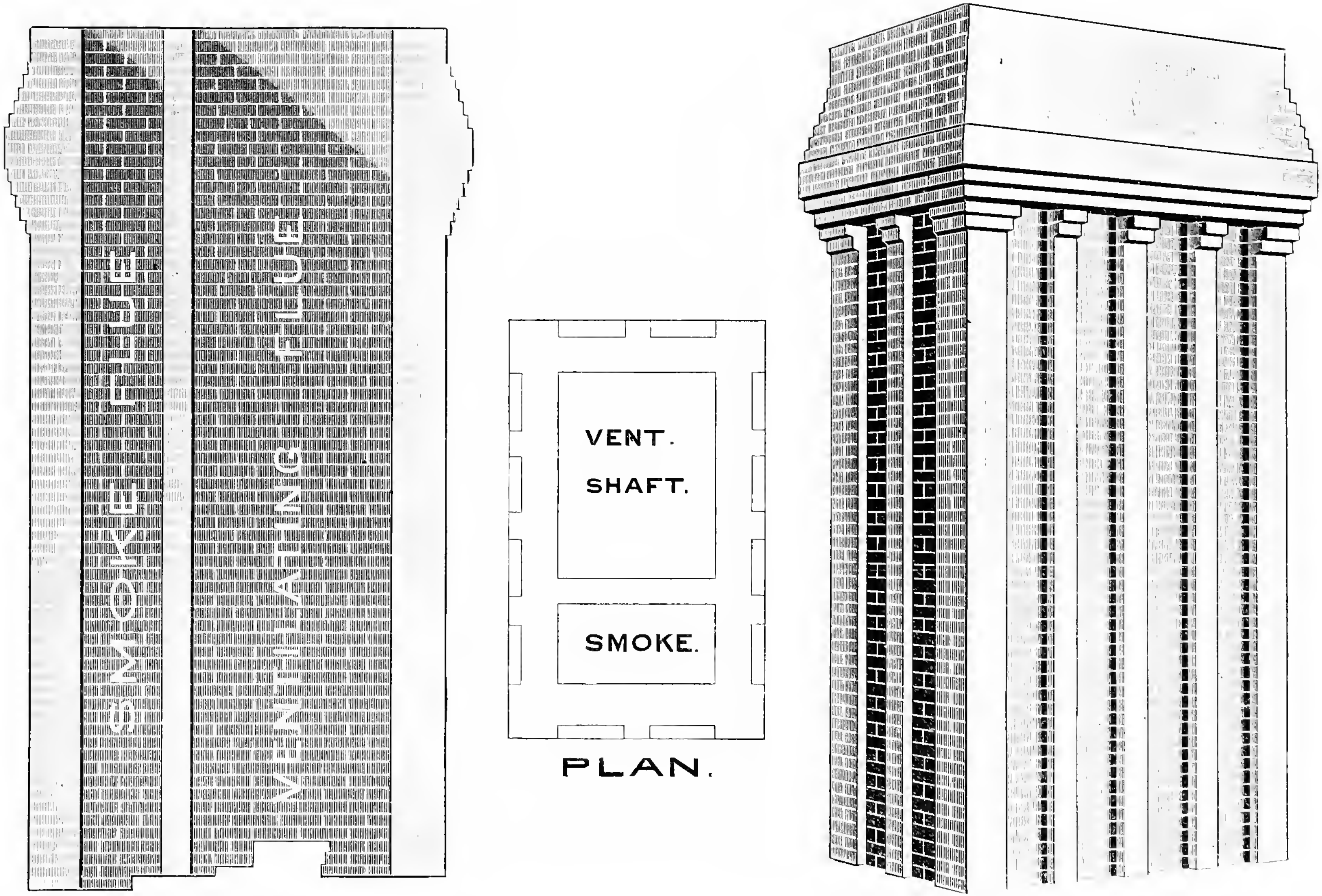
Dr. ——— : What other improvements have you made since you left the old company?

Mr. Smead : So many that, although we cast several tons of iron every day, I do not today use a pattern that was even *designed* six years ago. Come in tomorrow, doctor, and we will take up the subject again.

* * * *

Mr. Smead : You asked me yesterday, doctor, concerning recent improvements. I will call your attention to the first, namely, my system of "continuous ventilation." Previous to the introduction of this, with all kinds of apparatus, including our own, if the rooms became too warm and the occupant should close the register, entrance of air was stopped. I have often gone into schoolrooms where I knew the arrangements for ventilation to be the best, and found the air very bad, and especially would it be noticeable to one coming from outside, while those who had gradually become accustomed to it would not notice the impurity; but the process of slow poisoning was going on all the time, even though unnoticed by teacher or pupil. Upon inquiry, the



SECTION. PLAN. PERSPECTIVE.

DESIGN FOR SMOKE AND VENTILATING FLUE.

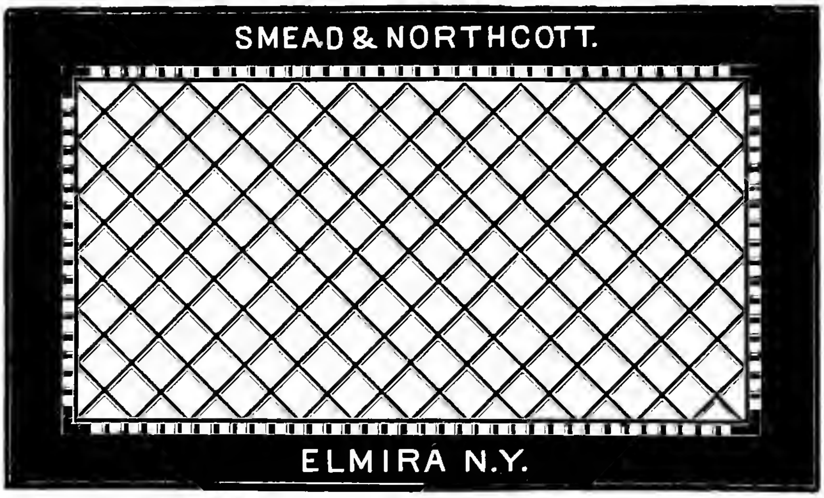
teacher would innocently reply, "The room becoming too warm, I closed the register," sometimes adding, "I guess the room has cooled off now, I will open the register." I determined to so arrange my apparatus in the future that when "the room became too warm," and the teacher decided to turn *off* the "heat," she will also turn *on* the "cold"; in other words, that when she *diminished* the flow of *warm air* she should in like proportion *supply cold air*. By an examination of these cuts you will see that I have so arranged the apparatus that I mingle the two currents, and that *air at any desired temperature can be secured through the register*, and this regardless of the carelessness or indifference of a teacher. (See cuts pages 21 and 23.)

Dr. ——— : Have you made any improvements in registers?

Mr. Smead: Yes, notice the one I have just shown you; there is more *hole* than *iron*, and with others there is more *iron* than *hole*.

Dr. ——— : Then you only use the iron as a screen?

Mr. Smead: That is it exactly. I would be better satisfied if there were no iron to obstruct the flow of air into the room. Any register obstructs to the extent of the size of the bars; but there must be something over the flue, and to get them as nearly right as I know how, I make them as you see represented here.


SMEAD & NORTHCOTT.
ELMIRA N.Y.

Dr. ——— : What did you commence to improve next?

Mr. Smead: The regulator. I made *eleven* before I got one that was practical.

Dr. ——— : This one seems very simple. (See page 21.)

Mr. Smead: So it does, but it cost me over $400. I sell them now at a profit for $3.

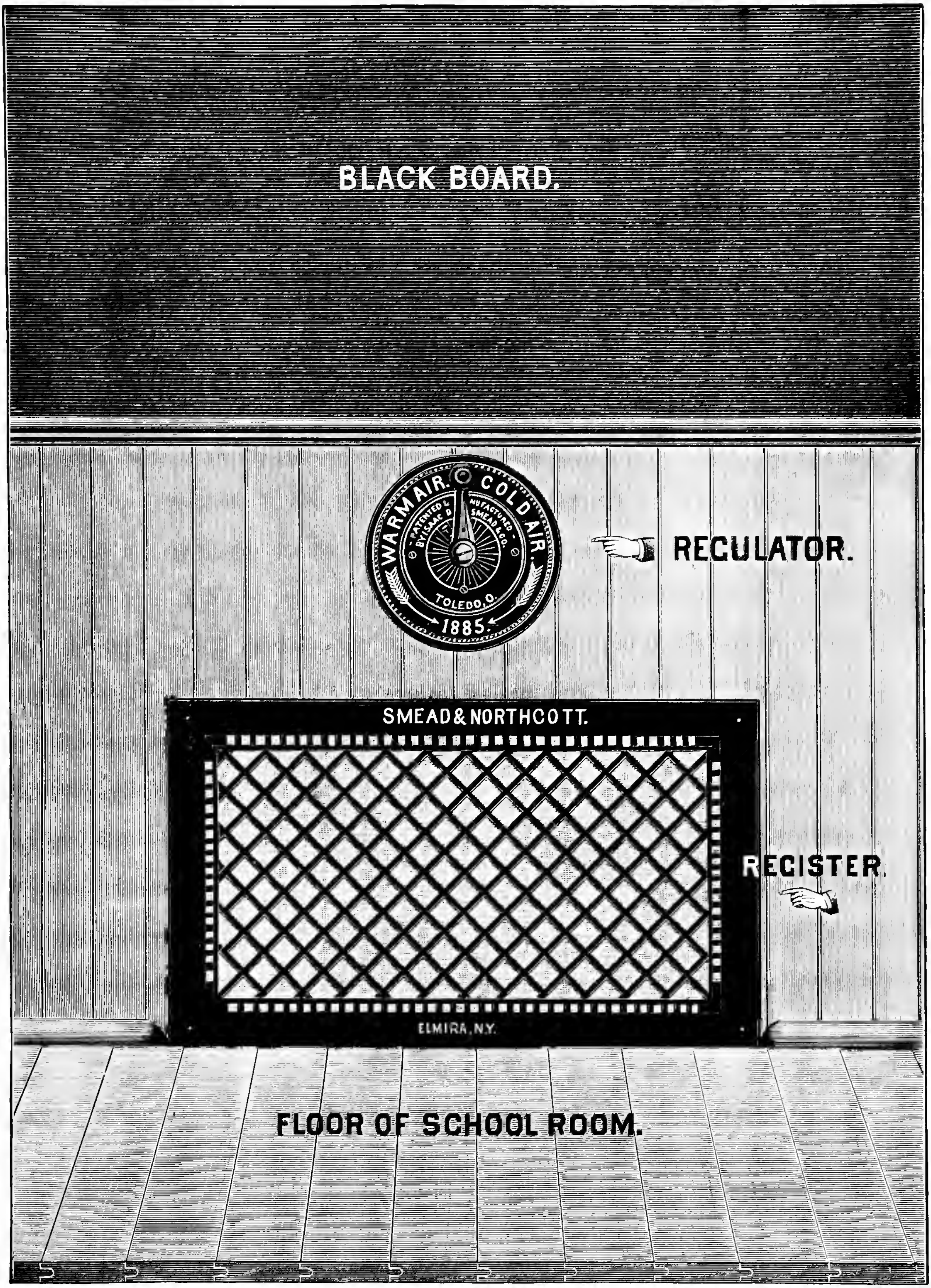
Dr. ——— : What was your next effort?

Mr. Smead: For several years the most serious complaint against our apparatus was the cost of renewal of the linings and grates. The burning out of the latter was the fault of the fireman; the loss on the former was occasioned, in my opinion, because they were improperly constructed. I spent several hundred dollars experimenting on new ones, and now have one that will last for years. I don't hesitate to guarantee them for five years, and they will last ten if firemen will use a little care. With the old apparatus it was often necessary to introduce two sets every winter.

Rochester, Ind., April 5, 1889.

Sup't Manning, Peru, Ind.:

Dear Sir,—Mr. Bartlett tells me that it has been reported to you that the dry closet system is not working well in our building. You certainly have been misinformed, as it works thoroughly well and we are satisfied with it. Heating and ventilation are entirely satisfactory. Yours truly, James F. Scull,
Sup't City Schools.


BLACK BOARD.
WARM AIR.
COLD AIR.
PATENTED & MANUFACTURED BY ISAAC D. SMEAD & CO.
TOLEDO, O.
1885.
REGULATOR.
SMEAD & NORTHCOTT.
ELMIRA, N.Y.
REGISTER.
FLOOR OF SCHOOL ROOM.

VIEW OF REGISTER AND REGULATOR.

Dr. ——— : Does your present apparatus cost the customer very much for repair?

Mr. Smead : Nominally nothing. Here is a table which I cut from the last annual report of the Board of Education of Columbus. It gives some interesting figures concerning the

COST OF STEAM-HEATING REPAIRS FROM 1879 TO 1888, BOTH INCLUSIVE.

BUILDING.	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	Total 10 years.
High	$41 25	$6 95	$448 90	......	$43 70	$205 76	$1,502 05	$66 85	$305 29	$1,751 19	$4,371 94
*Douglas..........	27 90	386 13	10 83	$4 08	4 27	158 00	36 13	55 85	231 00	676 00	1,590 19
†Front............	......	......	......	......	......	....	50 50	2 55	224 30	200 17	477 52
‡Garfield	......	......	......	......	......	3 00	....	4 00	185 25	42 10	231 35
Mound	7 50	2 25	....	246 00	84 52	33 85	50 55	64 85	169 50	42 00	701 02
Rich	26 28	......	6 50	......	......	113 55	16 24	8 25	2 00	567 20	740 02
Sullivant	1 00	647 30	8 35	......	......	15 20	1,652 15	113 23	249 00	152 10	2,838 33

*Finished in 1876. †Finished in 1885. ‡Finished in 1883.

Mr. Smead : My apparatus has been in use in Toledo schools six winters, and is now used, as before stated, in twenty-four buildings. One of the buildings is the High School building, containing twenty-four rooms besides the corridors; most of the others are twelve-room buildings. The city has never paid a cent for repairs, and, aside from grates and linings, they hold my guarantee for ten years on each apparatus, provided it has good care. By good care I mean about the degree of care you expect your hostler to give your horse. There are a thousand buildings containing my apparatus, and there are some mighty poor janitors. Recently complaint was made regarding work put in by us near this city, and sending our engineer to investigate the cause, he found the teachers complaining of cold schoolrooms. Going to the basement he found it in great disorder, dirt and ashes scattered all around, windows covered with dirt, the fire boxes of the furnaces *two-thirds full of fuel, and the janitor in the act of throwing in more*, when the following conversation ensued:

Engineer : Hold on! What are you doing that for?

Janitor : To warm the rooms. The teachers are scolding me because their rooms are too cold, and I am going to warm them *if it takes all the coal in the basement* or *melts the furnaces!*

Engineer : Have you read your instructions?

Janitor : Yes, there they are; but I can never warm the rooms if I follow them.

Engineer : Have you tried it?

Janitor : No; but I am an old steamboat fireman on the Ohio river, and know all about firing.

Engineer : When did you clean your furnaces?

Janitor : Oh, they are all right; I gave them a good cleaning last spring!

Engineer : I am the one who sold and guarantees this apparatus, and will teach you how to run it.

He then spent an hour with him in cleaning out the furnaces (two), and after removing three wheelbarrow loads of soot, ashes, cinder, coke and coals, with four or five inches of live coals on top of the grates, he put in a small amount of coal, scattering it well over the top of the burning fuel, and in less than an hour every room in the building was warm. The following morning he superintended the firing, and in less than an hour he warmed the entire building with *one-half the fuel usually used.* Now, doctor, under those circumstances I guarantee no more than you would if your patients did not take your medicine. Here is an item I cut from the paper today; it refers to one of the largest buildings I ever warmed:

> Before Smead's man came here from Toledo, two weeks ago, we were burning just twice as much coal in the Court House furnace as we now are doing under his direction. The coal in the furnace should not be over six inches in depth at any time, and should at all times be carefully attended to so as not to let the coal burn out. With a little attention to business, there will be no trouble experienced in heating up the building, and a great deal of coal saved.

THIS LITHOGRAPH IS MADE TO ILLUSTRATE

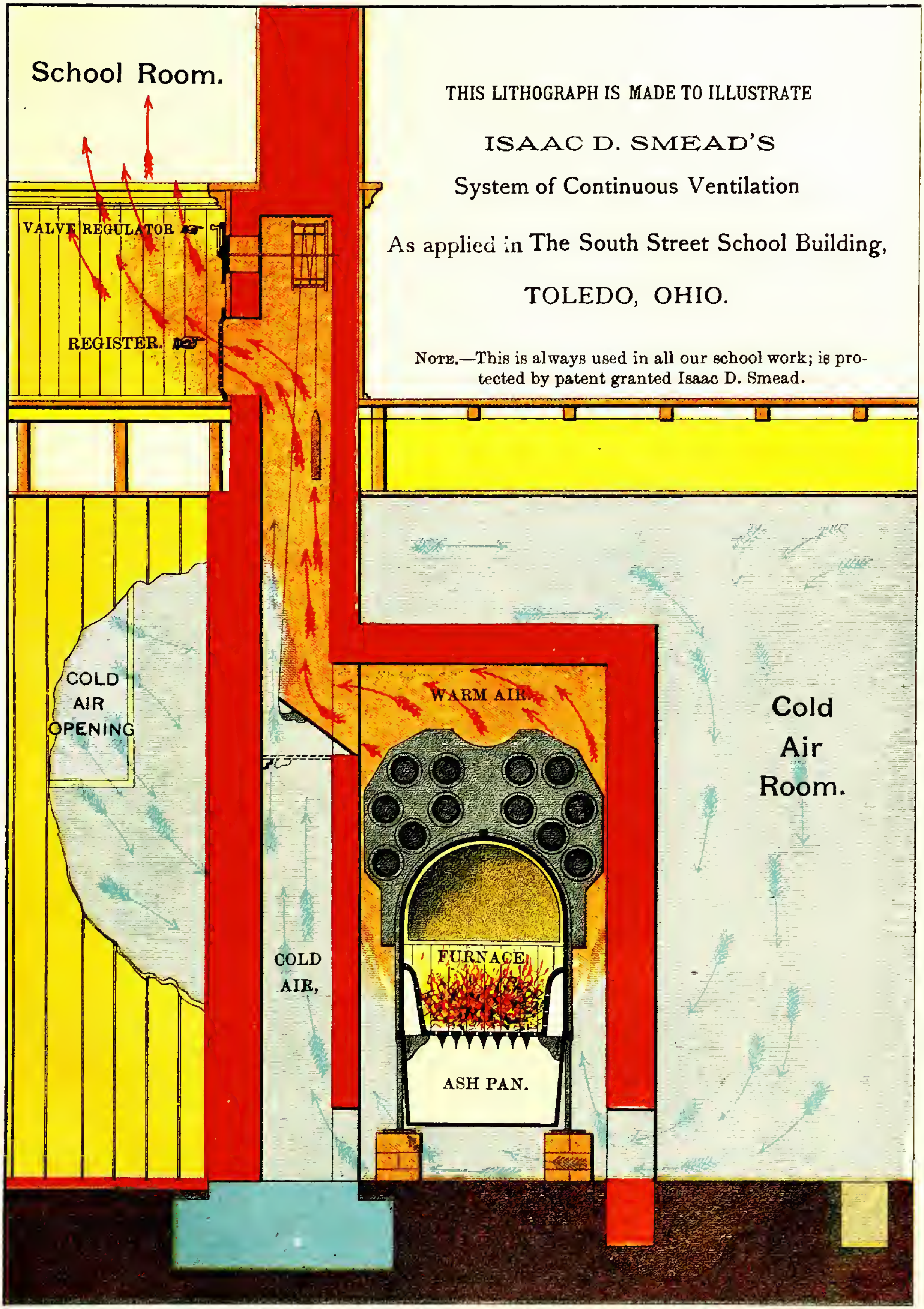
ISAAC D. SMEAD'S

System of Continuous Ventilation

As applied in The South Street School Building,

TOLEDO, OHIO.

Note.—This is always used in all our school work; is protected by patent granted Isaac D. Smead.



Section, Line B. B. Showing Cold Air Room, Furnace, And Warm Air Flue.

(South Street School Building, Toledo, Ohio. Also in fifteen other school buildings, Toledo.)

Dr. ——— : Are your instructions to janitors hard to understand or difficult to follow?

Mr. Smead : Read them and answer the question yourself; here is a copy:

(*a*) Never build a fire with cold air shut off from furnace.

(*b*) Keep the furnace clean.

(*c*) Do not allow ashes to collect under grates.

(*d*) In school buildings containing the dry-closet system, the windows opening into cold-air rooms must never be entirely closed.

(*e*) To check the fire, open one of the flue doors.

Dr. ——— : Easy enough if a man is disposed to do his duty.

Mr. Smead : The next improvement in the heating apparatus was its almost entire reconstruction, whereby my improved lining was introduced, a deeper ash-pan substituted for the old shallow one, an ornamental and more suitable front added, the pipes at the rear of the fire box abandoned, and the top portion of the fire box extended. This latter so-called improvement was a compromise measure between the Chicago company and myself, and my opinion then was that it was a step backward, and experience has since demonstrated that I was right. Here are the cuts representing the apparatus as improved in 1885. The front, the deep ash-pan, linings and grates are mine; the extension at rear I never approved. (See cuts pages 26, 27 and 28.)

Dr. ——— : Do you still retain connection with the Chicago house?

Mr. Smead : Socially and in the ownership of all old patterns, patents and machinery, yes. We also aid each other in many ways, but do not share each other's gains, losses or opinions, although as a rule they copy almost everything I do. They adopt what I have, by experiments, and sometimes expensive ones, demonstrated to be correct.

Dr. ——— : But none of these cuts represent the apparatus now in use—the air-warmer standing in your salesroom.

Mr. Smead : No, they do not. I have shown them to you that you may see the growth or evolution from the first. I am not ashamed of them; they have done more good than the world will ever know; but the truth is, doctor, I have *never* believed the tubular furnace to be the best apparatus for air-warming. But until during the last few years I have not been in a position to make an apparatus that did cover my ideas in all points. I do not believe that a round pipe is the best form to be used as a conduit for the products of combustion to warm a surface with which a rapidly moving current of air is to be heated. Here is a cut of the Smead air-warmer you see standing in the salesroom below (see cut page 29); but let us first examine the furnace manufactured previous to this one (on page 27). You will notice that in its construction we break every rule we argue for when we design a plan for warming a building.

Dr. ——— : How so?

Mr. Smead : We say that the warmest air in a *room* is at the top.

Dr. ——— : So it is.

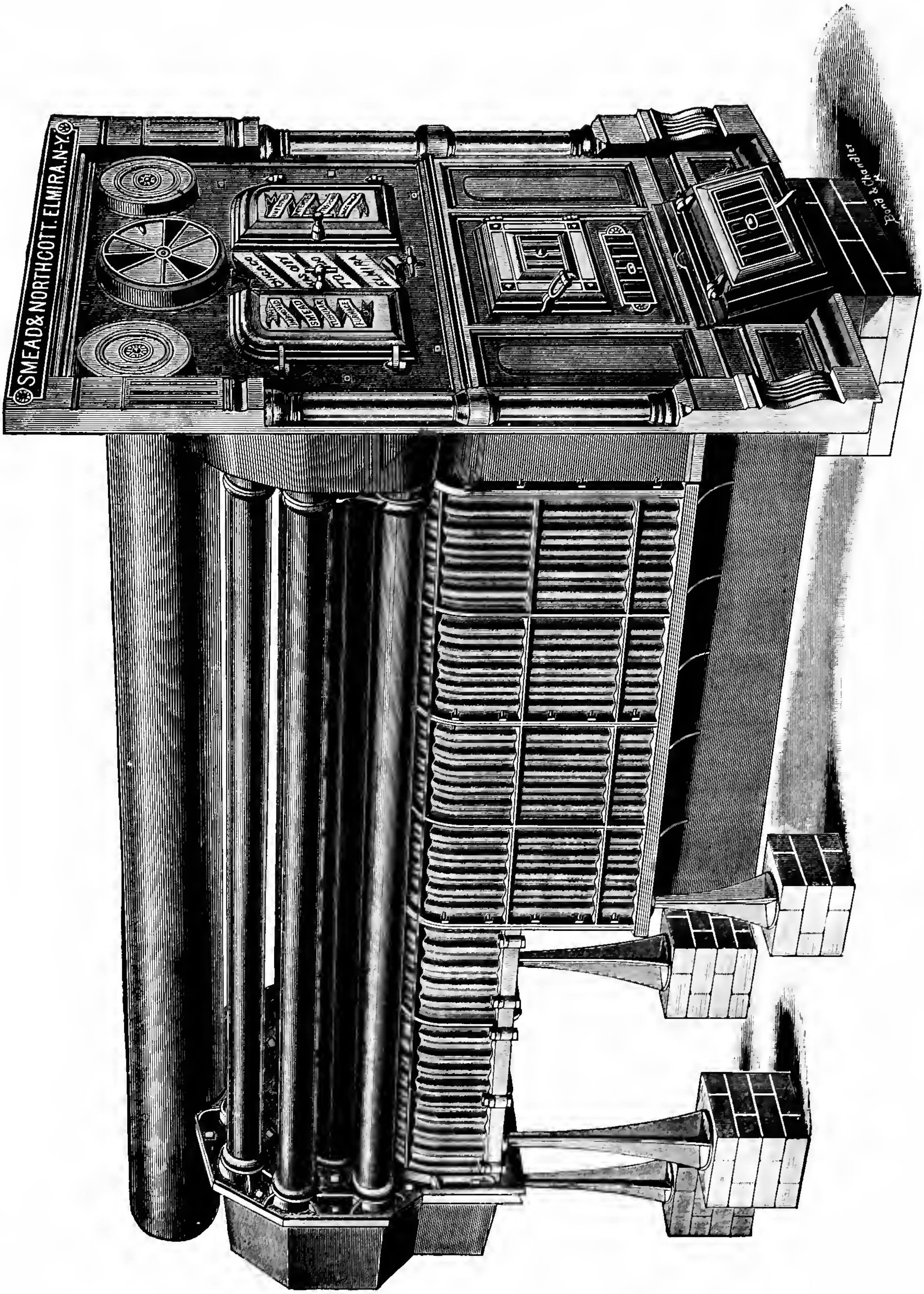
Mr. Smead : We tell our customers that the ventilation of a *room* should be on a level with the floor, that the coldest air may be drawn off.

Dr. ——— : O yes, I see; with the Ruttan furnace you ventilate your fire box at the top, thereby drawing off the hottest products of combustion.

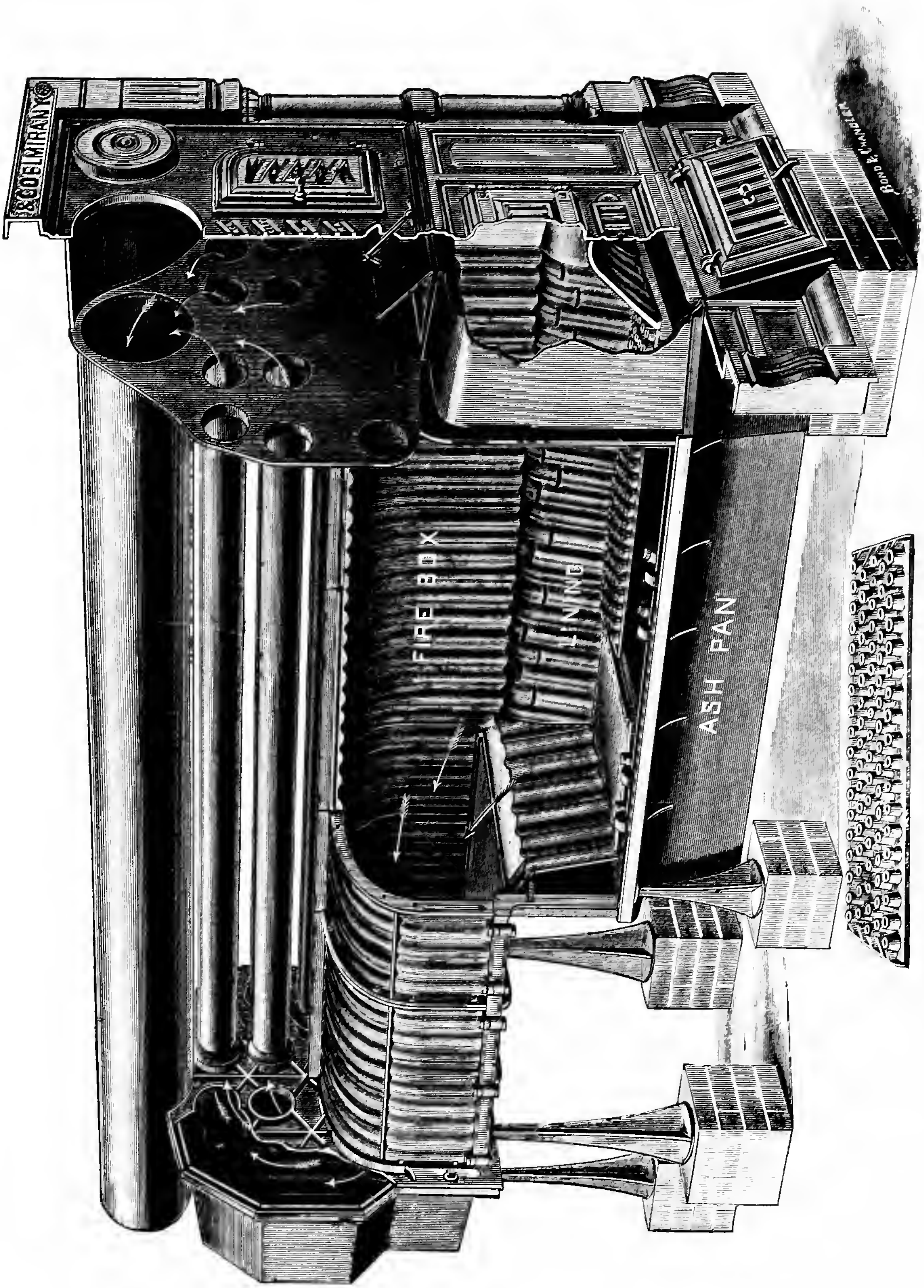
Mr. Smead : Yes, and that, too, through a very large flue or "extension" into the back breeching or large chamber at the rear.

Dr. ——— : You then exhausted that at the *top* by way of the long pipes to front breeching, then that again at the *top* by way of the large pipe to the smoke-flue. I don't see how you could get your apparatus warm with any degree of uniformity.

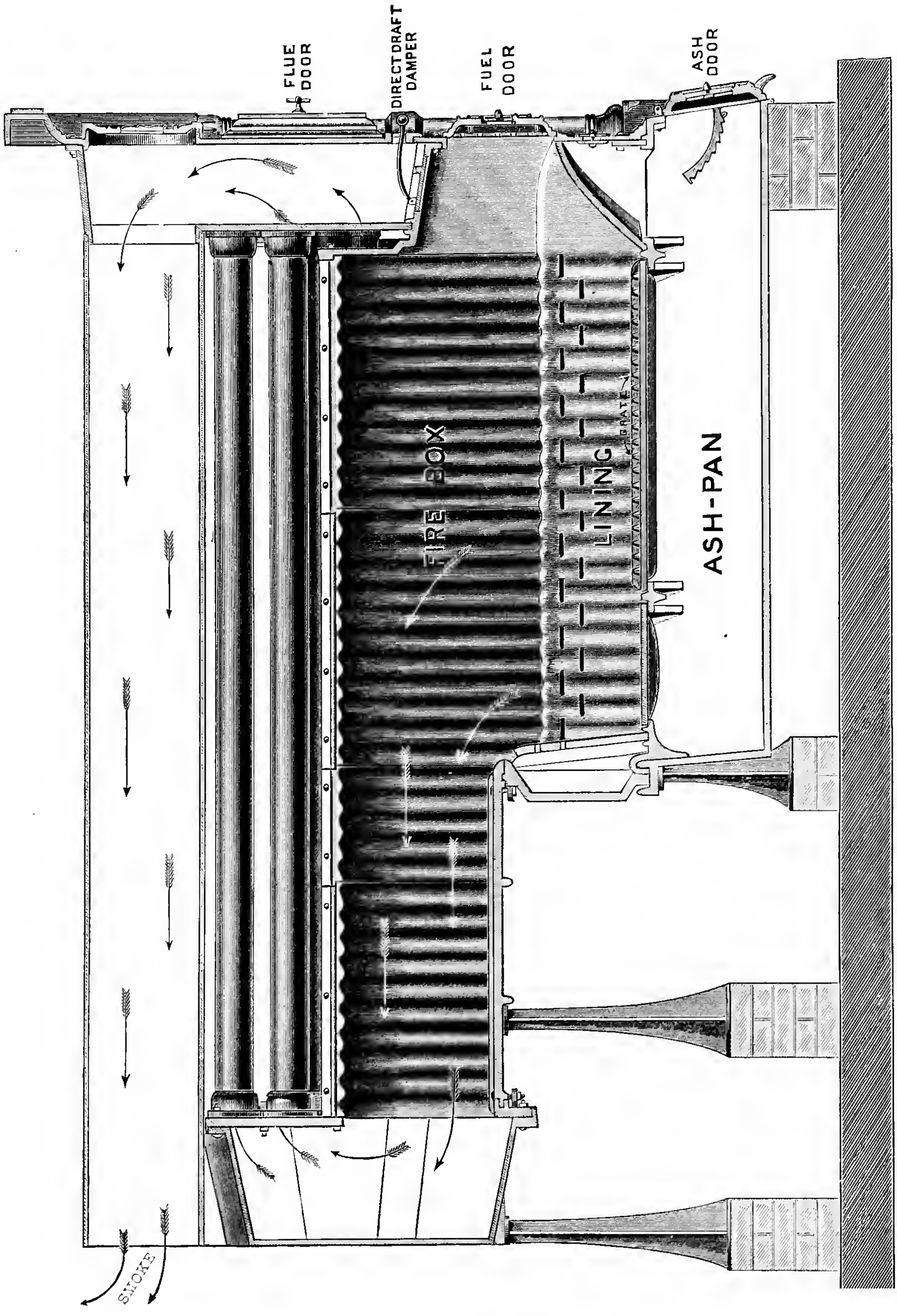
Mr. Smead : We could not; the top of the fire box, pipes and extension would be very hot, while the lower portion would be many degrees cooler. The bottom of "fire box extension" would soon be covered with fine ashes, and lower half of the pipes with soot, and both ashes and soot being non-conductors of heat, would render practically valueless those portions of the apparatus for heating surface.



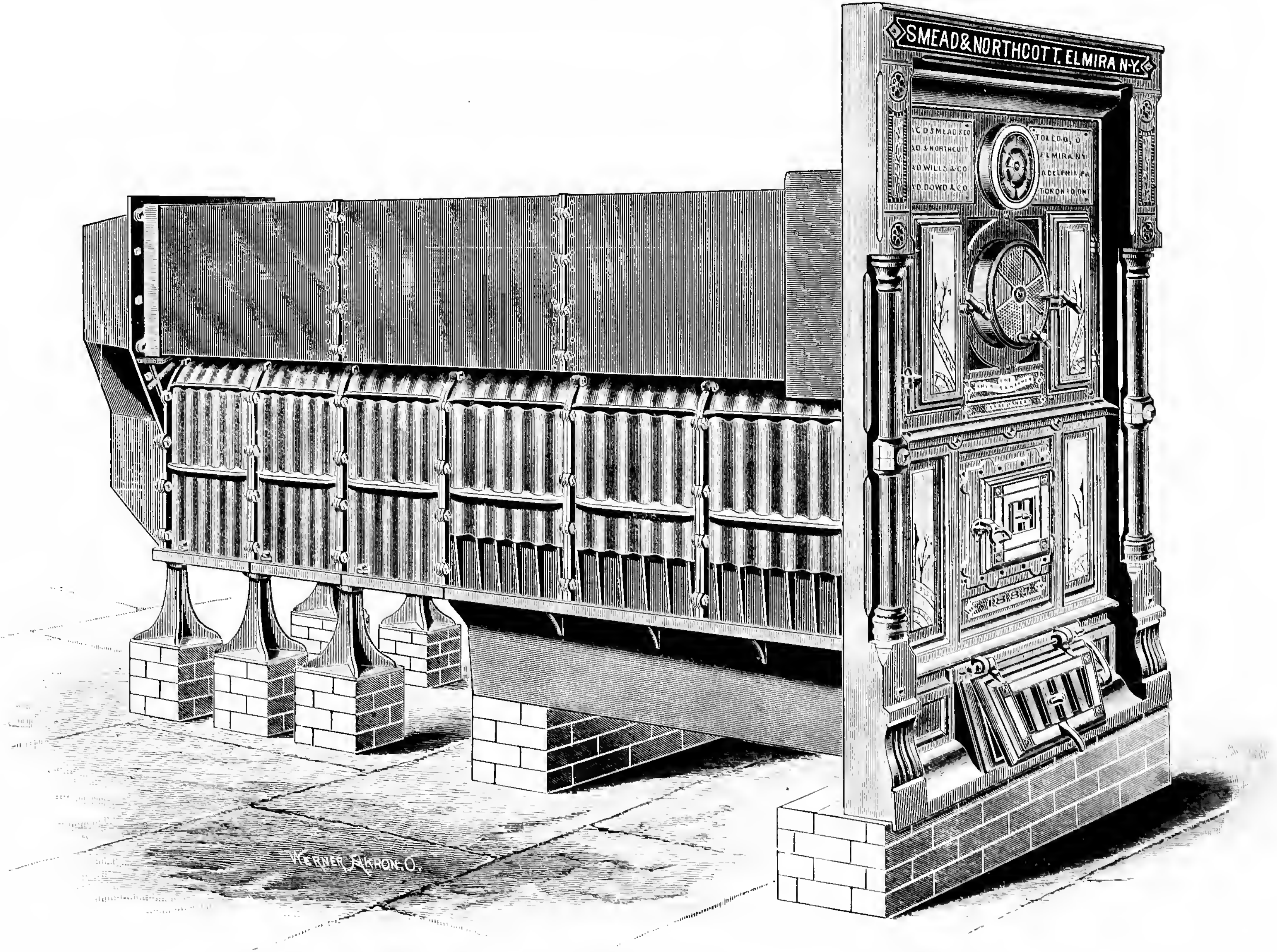
THE AIR-WARMER AS IMPROVED IN 1885. (See page 25.)



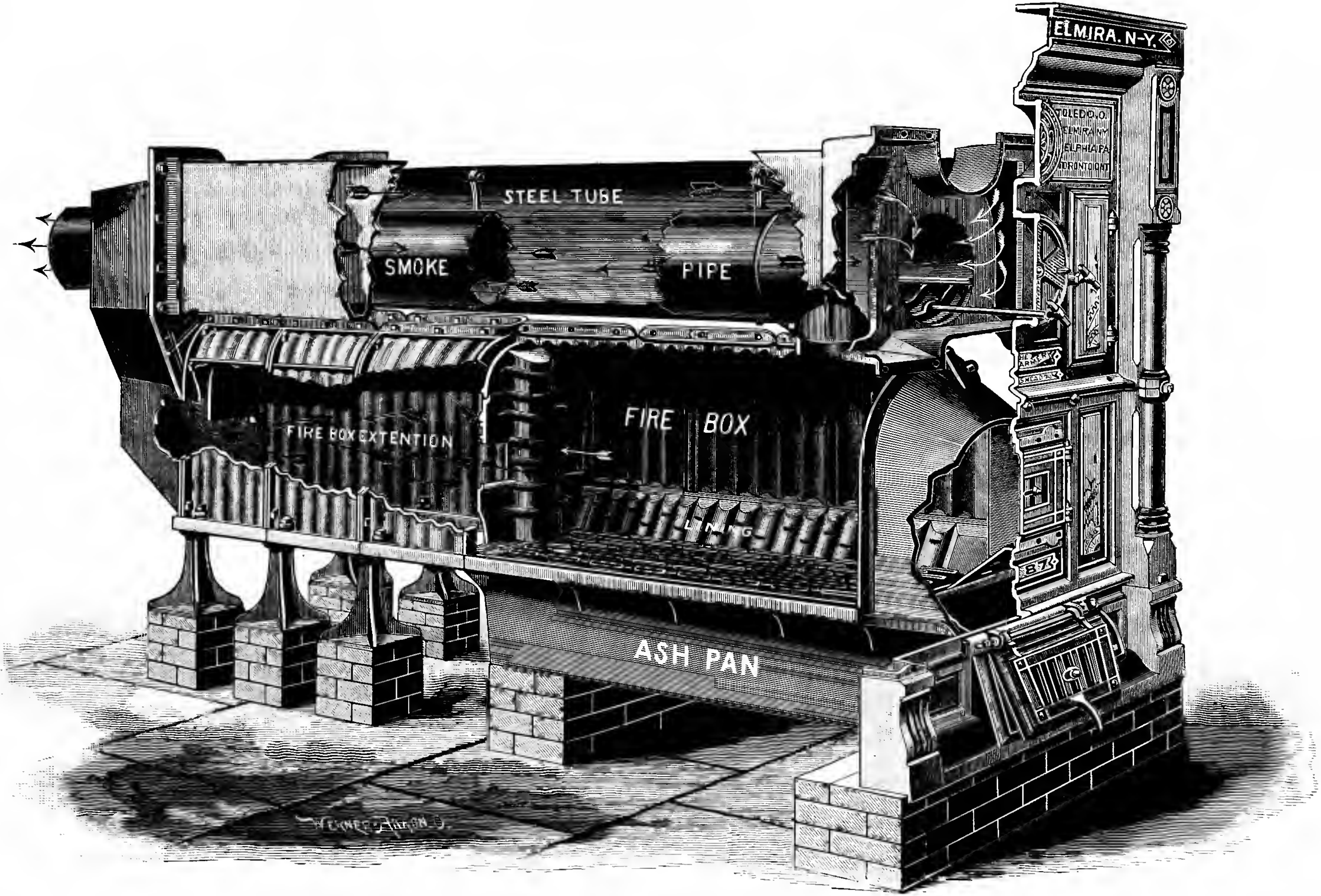
INTERIOR VIEW OF AIR-WARMER AS IMPROVED IN 1885. (See page 25.)



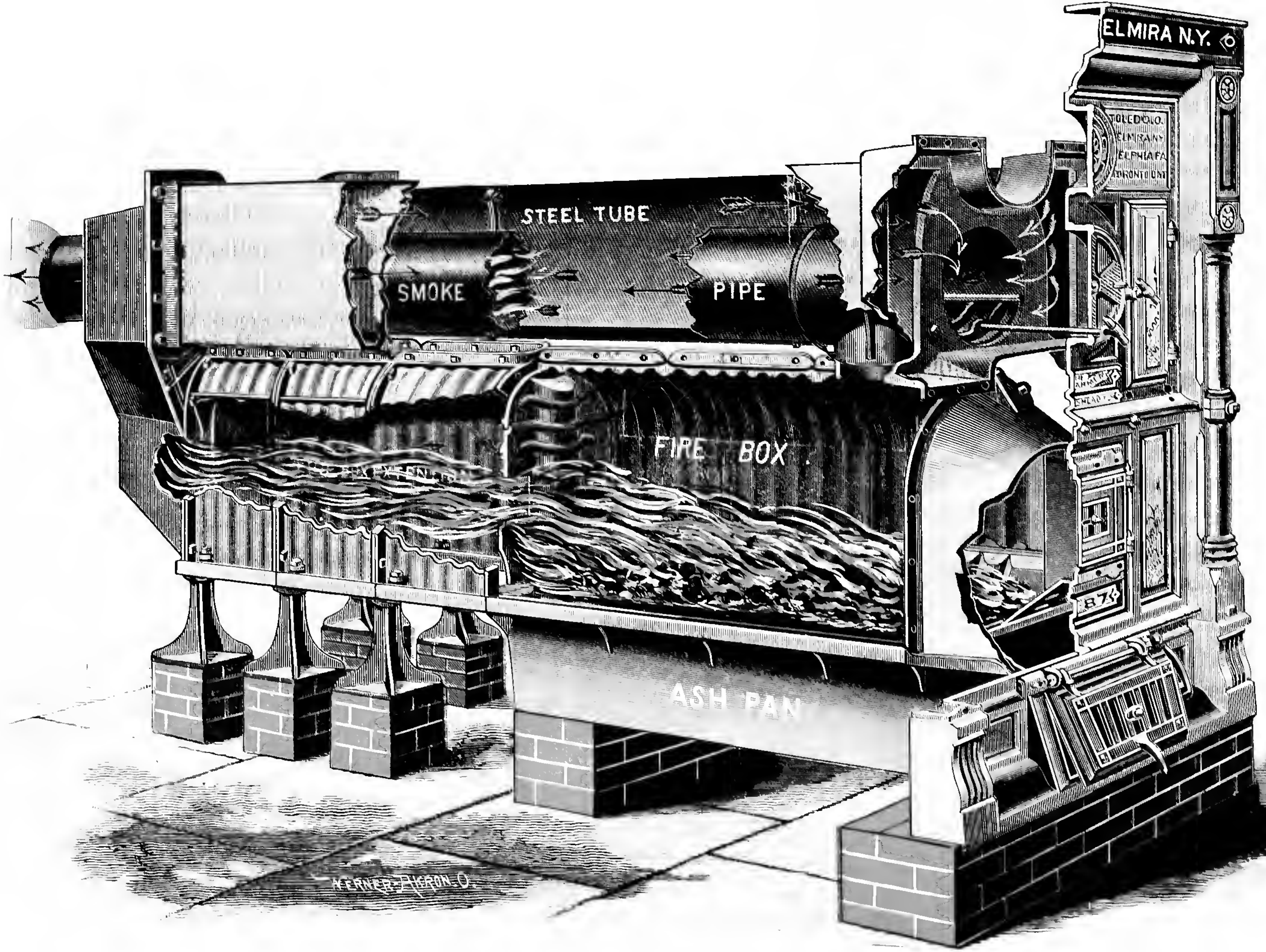
LONGITUDINAL SECTION OF AIR-WARMER AS IMPROVED IN 1885. (See page 25.)



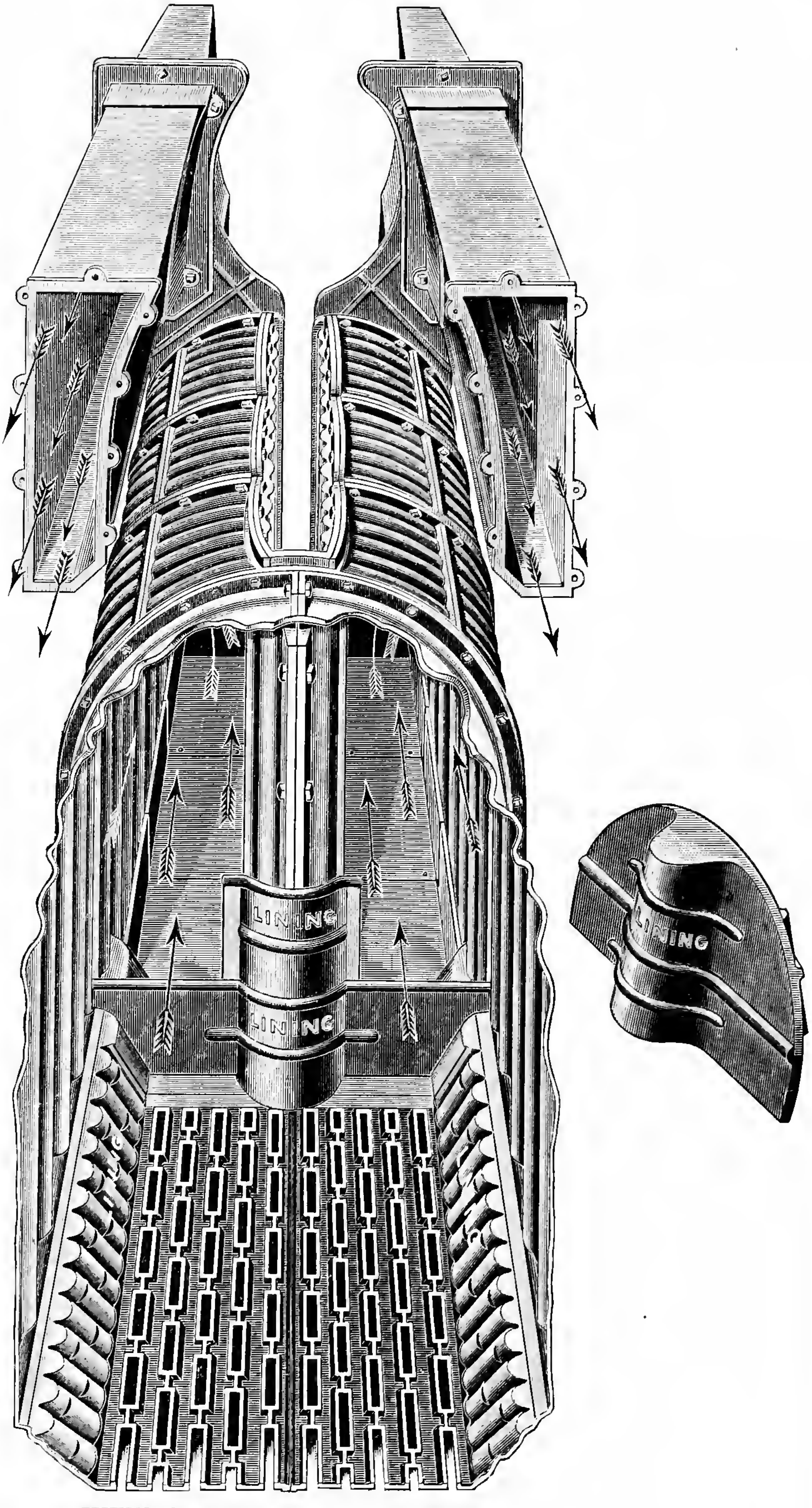
THE SMEAD AIR-WARMER, PATENTED BY ISAAC D. SMEAD, 1888. (See page 25.)



INTERIOR VIEW OF THE SMEAD AIR-WARMER. (See pages 25, 35 and 36.)

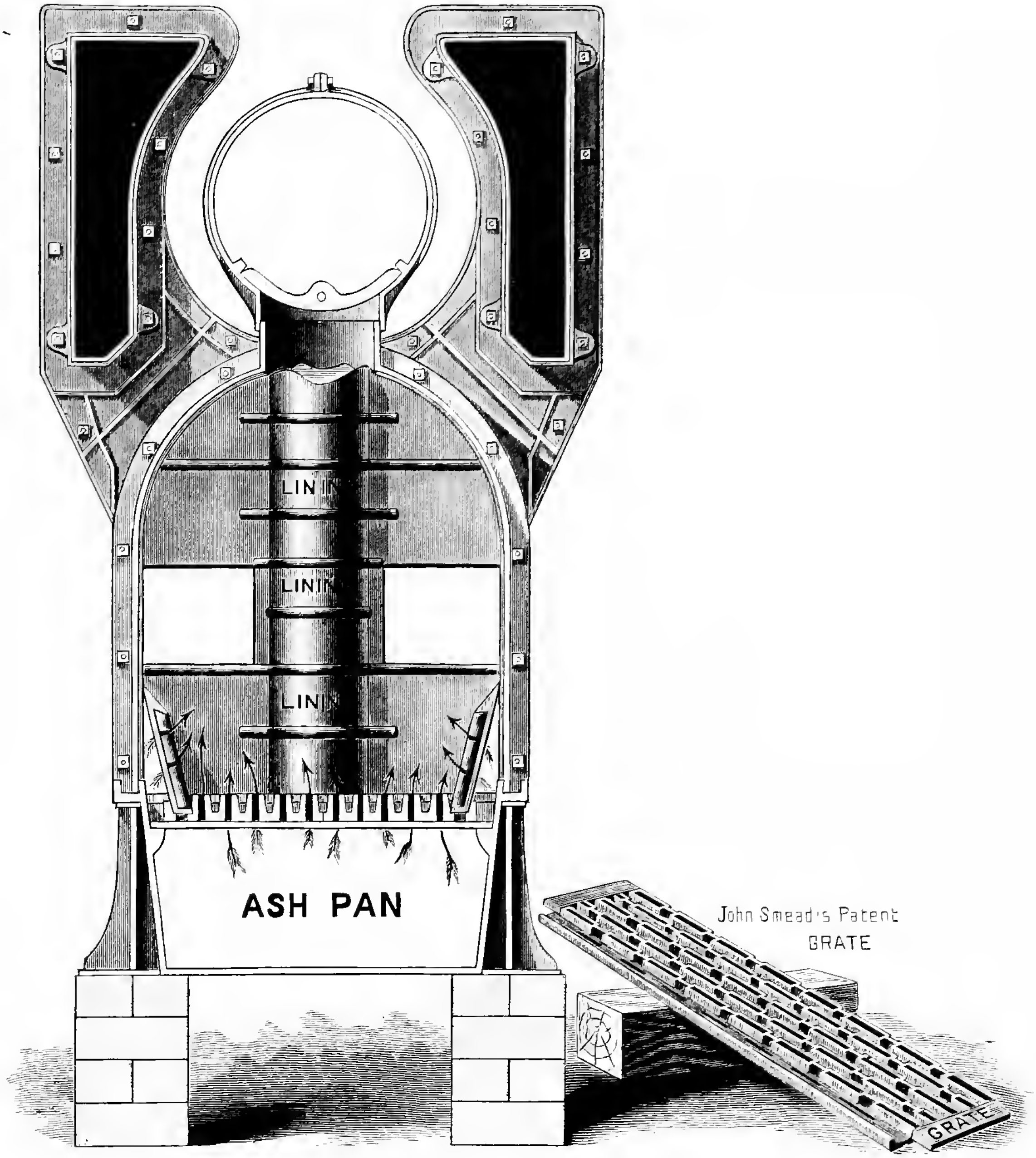


INTERIOR VIEW OF SMEAD AIR-WARMER SHOWING FIRE. (See pages 25, 35 and 36.)



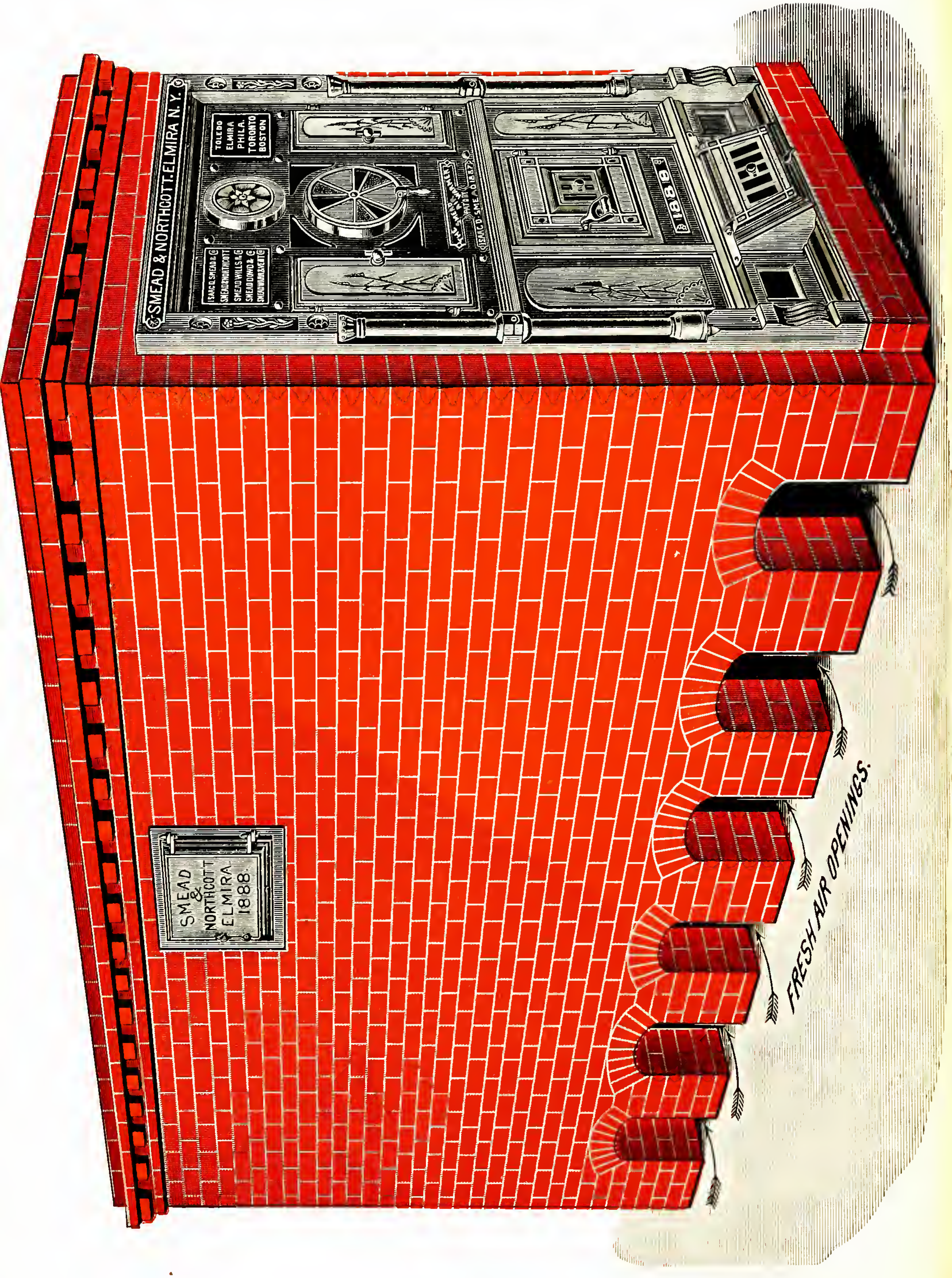
VIEW OF SMEAD AIR-WARMER,

With front portion cut away, showing interior of Fire Box, Grate, Linings, Rear Extension, etc.
(See pages 25, 35 and 36.)



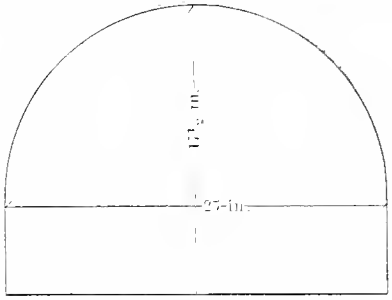
SECTIONAL VIEW SMEAD AIR-WARMER.

Through Steel Flues, Smoke Pipe, Fire Box and Ash Pan. (See pages 25, 35 and 36.)


SMEAD & NORTHCOTT. ELMIRA N. Y.
TOLEDO
ELMIRA
PHILA.
TORONTO
BOSTON
ISAAC D. SMEAD & Co.
SMEAD & NORTHCOTT
SMEAD WILLS & Co.
SMEAD DOWD & Co.
SMEAD WARM & VENT'G Co.
THE SMEAD DRY WARMER
PAT'D BY
ISAAC D. SMEAD 1887
1888
SMEAD
&
NORTHCOTT
ELMIRA
1888
FRESH AIR OPENINGS.

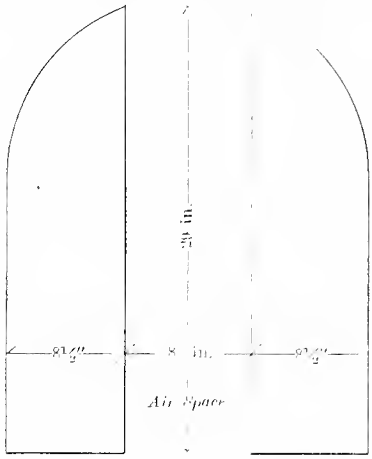
Dr. ——— : I fully understand the old one, and acknowledge its defects ; now show me the new one. (See cuts pages 29, 30, 31, 32, 33 and 34.)

Mr. Smead : There were many more defects to which I have not called your attention, but here is the new one. First examine the fire box and you will notice that it is not exhausted of its smoke, flame and other gases at the *top*, but at the *bottom*, or nearly on a line with the burning coal ; and the result is an evenly warmed fire box, except directly at the point of exit, where it is some hotter. After the smoke and flame leave the fire box, instead of passing through the very large extension or large flue with the warming surface at the most distant point possible from its center, I change the shape of this flue, shaped thus :



FORM OF FIRE BOX EXTENSION,
1885 Pattern.

to two narrow upright flues, shaped thus :

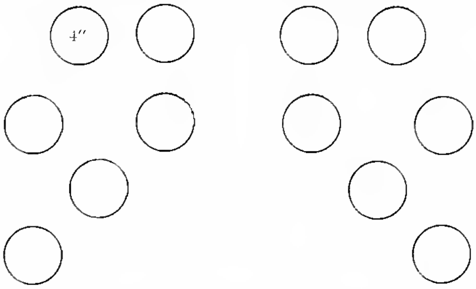


FORM OF FIRE BOX EXTENSION,
1888 Pattern.

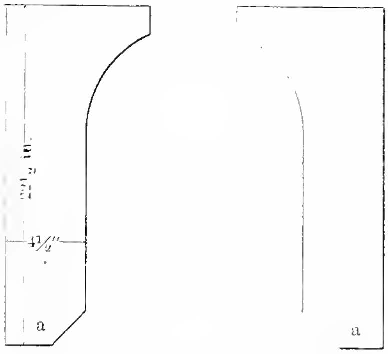
and exhaust them again at the bottom, at the rear, into two back chambers, which are also *long* and *narrow*.

Dr. ——— : I notice that you *keep the "center point" very near the exterior.*

Mr. Smead : Yes, a necessary thing to do to produce the best results. These two back chambers are exhausted by two long steel flues connecting with the front chamber, and instead of this form being round, as with the old, I make them thus : *long* and *narrow*. No soot or ashes can collect on the sides or top, only at the bottom at points marked "a" "a." With the old furnace the janitor had *twelve* flues to clean, with this but *two*.



FORM OF RETURN PIPES,
As used from 1867 to 1888.



FORM OF RETURN FLUES,
1888 Pattern.

Dr. ——— : With the old air-warmer the large round pipe exhausted the front chamber at the top, while with this I see that you keep it on a line considerably below the top of the two long, narrow flues.

Mr. Smead : Yes, and in this manner, to a considerable extent, I exhaust both the long flues, back and front chambers, some distance below their top, instead of at the top as formerly done with the old one.

Dr. ———: Do you find a saving in fuel?

Mr. Smead: Yes, about thirty per cent. Last fall I placed two of each kind in the same building to get at comparative results.

Dr. ———: I see you have changed the location of direct-draft damper. Why?

Mr. Smead: With the old one, located as it was, the heating surface of the front end of fire box and the bottom of front chamber was lost, and flame coming so near the front (which you will notice is somewhat ornamental) that it was liable to crack the castings; while with the Smead air-warmer the direct draft is direct into the smoke-flue.

Dr. ———: What is the direct draft for?

Mr. Smead: Simply to be used a few minutes when fires are started; never after that. The furnace will not warm any more air than the ordinary round furnace with this damper open. There are many other points in which this differs from and is better than the old, but I think I have mentioned the principal ones. *No furnace is of more value to the purchaser than so much old iron if it is not properly set*, and this brings us back to the question of ventilation and engineering. We will commence on that when you come in again.

Dr. ———: All right; but one more question: What did this furnace cost you, the first one you made?

Mr. Smead: I worked on the drawings and patterns for eighteen months, and the first air-warmer manufactured cost me a little over $9,000; I sold it for $600. I don't believe you could buy it back from its owners for $9,000 if they could not buy another. Come in tomorrow and I will show you some cuts illustrating position of air at different temperatures, and I think I will convince you that there is but one correct system of construction if desired results are obtained. I have never failed but once to convince even the most skeptical.

* * * * * * *

Dr. ———: You said yesterday that you never failed but once to convince even the most skeptical.

Mr. Smead: I was once awarded a contract on a school building where the architect insisted that the exit for the foul air should be at the ceiling instead of at the floor. I failed to convince him of his error, but he did consent to my placing registers at the floor line as well as at the ceiling; this as a compromise between us. The real reason why he insisted on his way was because his plans were so drawn when I was called, and he did not want to admit that he had made an error.

Dr. ———: But how could you warm a room with an opening at the top?

Mr. Smead: There wasn't any opening there! I instructed my superintendent to build a solid brick wall back of the register, which he did, painted the wall black, set his register, and hung the cords; on one cord handle was the word "open," on the other "shut."

Dr. ———: Did the old gentleman ever discover the deception?

MAYVILLE, Mich., March 19, 1889.

This is to certify that the "Mayville Public Schools" have now used the complete Smead system of warming and ventilating, including the dry-air closets, since opening school in our new school building last October; that our rooms are large and high, and notwithstanding we have been compelled during the past winter to burn inferior and green wood, still the temperature has always been kept comfortable and the ventilation simply perfect. There has been no headache, no dullness, no want of pure air. We consider the system as near perfection as has yet been attained.

The dry-air closets are beyond question the *ne plus ultra* in that line. There is no drainage, no smell, no trouble. We believe in this system thoroughly, individually and officially.

A. B. MARKHAM,
Chairman School Board.
ARTHUR PEITCH,
Director.
W. B. CURTIS, M. D.,
Member School Board.

Mr. Smead: No. There were two eight-room buildings so arranged, and he admitted that they were the best warmed and most thoroughly ventilated buildings he had ever seen, and since that date (1883), I have furnished warming and ventilating apparatus for every school building he has erected—over twenty-five in number.

Dr. ———: Does he still insist on ceiling ventilation?

Mr. Smead: The next year he did, and I fixed them as before. The black register, blue cords and gold bronze were very ornamental! After the second year he simply made his designs for the buildings and sent them to me, and I arranged the flues, etc., as I wished, and nothing has ever been said about the matter. As evidence of the successful operation of my plan, here is the report of a chemist who examined the buildings containing "top and bottom ventilators":

LABORATORY OF THE CHEMIST,
[*]———, February 26, 1885.

THE HONORABLE ———

Gentlemen,—I have the honor to report that, in compliance with directions of Commissioner ——— ——— to make tests and analyses of the atmospheric air of the "———" and "———" school buildings, I have performed and make the following statement:

On the 17th inst. I made some tests in both of these buildings, which lead me to the following conclusions as to the normal condition of the air therein. The tests made in the ——— building were in School No. 9, on the third floor, containing 56 white children, and in School No. 6, on the second floor, containing 57 colored children. On the 25th inst. I returned to the ——— building in order to make a quantitative analysis of the air.

The process followed by me is that laid down by Boussingault, based upon the absorption of carbonic acid by caustic potash and moisture by strong sulphuric acid, and finally the absorption of oyxgen by copper, etc.

The result of these analyses (taking the air from various heights in the school) are as follows:

Outside air	.0003 Carbonic Acid.	23.00 Oxygen.	By weight.
Air ——— School			
Air ——— School No. 9	.00045 " "	22.94 "	

It is therefore concluded that the air in the ——— School is of normal condition, which is attributable to good ventilation of the rooms.

It is the atmospheric air which is brought in a large volume by the heating apparatus from outside into these buildings; and the warm air of the rooms, finding an outlet into cold conduits, effects a constant renewal of air. Herein lies the secret of the small quantity of carbonic acid found in the rooms thus ventilated.

This report refers more particularly to the ——— building. I intend to again visit the ——— building, and make an additional analysis of the atmospheric air therein, the report of which will be forwarded hereafter.

Very respectfully,

——— ———, *Chemist*, ———.

LABORATORY OF THE CHEMIST,
———, March 3, 1885.

THE HONORABLE ———

Gentlemen,—Yesterday I again visited the ——— School building, and made there a quantitative analysis of the air in Room No. 4 on second floor, while occupied by 52 colored children and one teacher.

Result of analysis by weight:

Carbonic Acid—.0004. Oxygen—22.98.

This air is of normal condition.

Very respectfully, your obedient servant,

——— ———, *Chemist*, ———.

Dr. ———: Was your treatment of the architect fair?

Mr. Smead: I only considered final results; they are satisfactory to taxpayers. As further evidence of the ignorance and blindness of some who should take an interest in sanitary matters, I will relate an incident in connection with one of these very schoolrooms. One day my engineer visited a schoolroom and asked the teacher how she liked the system of warming and ventilating. She replied: "The warming is all right, and whenever the air is bad I *pull this cord and open the register up there, and in a very few moments the air here is delightful.*" I have always thought that teacher a relative of a friend of mine who, to get better air in his sleeping-car berth, raised the sash a few inches, fastened it in position with his knife, enjoyed the improved (?) condition of his berth, and in the morning learned that he had only raised the inner sash of the two that are generally used in sleeping-cars. He had not changed the condition of the air in the slightest degree, but he *thought he had;* and the imagination has very much to do with our happiness or unhappiness. I told you the first time you came in that I wanted you to be guided by *facts* rather than by notions or *theories*, and have told you this incident to illustrate the necessity of careful investigation. As a rule the teachers give very little thought to the sanitary condition of their rooms. Not long ago a teacher called my attention to "a strong current of air coming into the room at the ventilating register"; she could feel it with her hand. I asked her for a sheet of paper, and she handed me a writing-book. I placed it near the register, and the force of the air going *out* was so strong that it was firmly held against the iron. She expressed great surprise, and from that day to this has been a great friend of our system. But the "system" is the same as when she complained that her room was not well ventilated!

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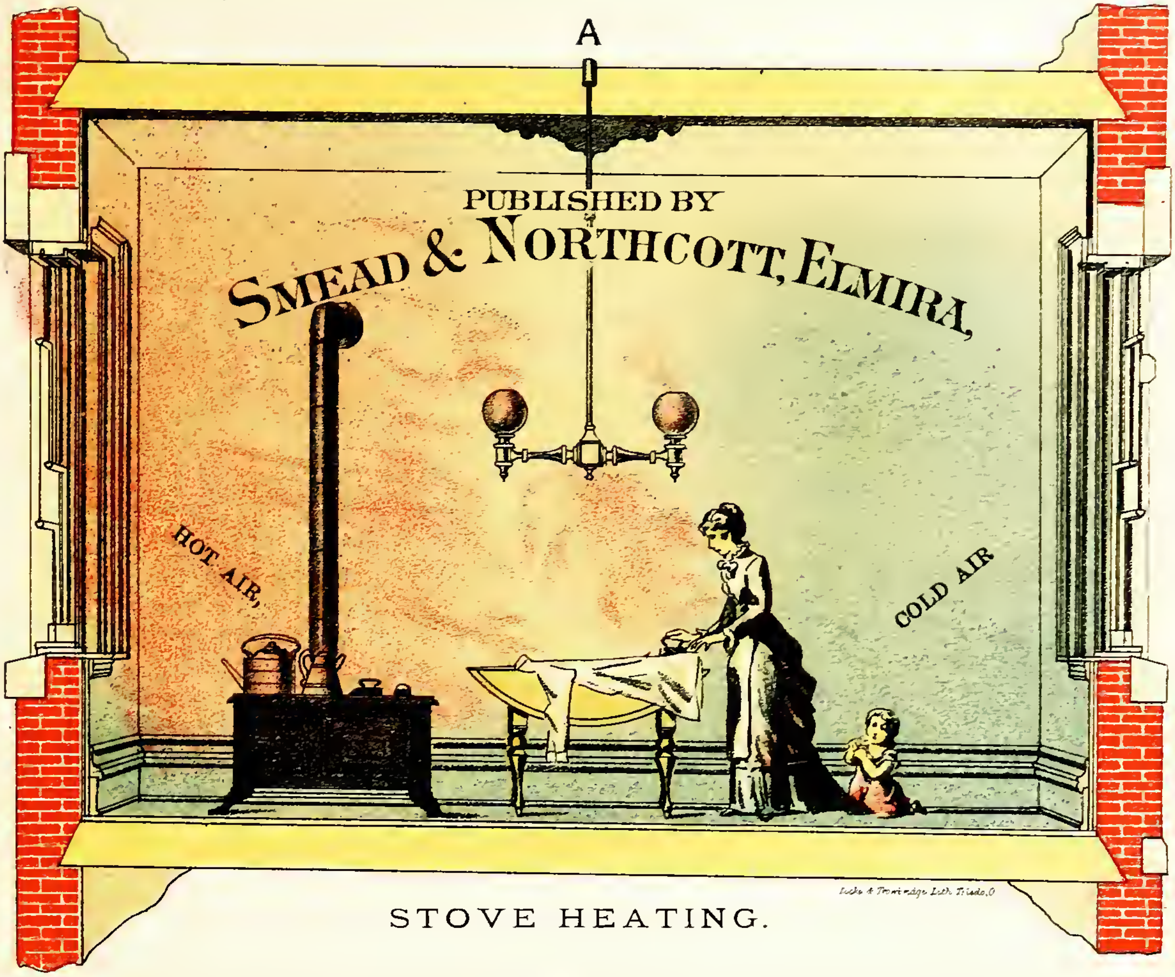
[*] For reasons that the reader can readily understand, I do not publish the names, but can show the originals if anyone wishes to see them.
ISAAC D. SMEAD.

SCRANTON, Pa., December 6, 1887.

COMRADE ALEXANDER:

Dear Sir,—Your favor of this date is at hand. I am glad to give you what information I can with regard to the Smead system of ventilation as I have gathered it from observation and inquiry. I want to impress on you to start with that I have no personal interest in this system, my interest and advantage being rather with the old or other systems. Mr. C. F. Mattes, the Chairman of the Select Council; Mr. T. H. Watts, the Chairman of the Common Council; Mr. E. L. Walter, the architect of our city building, and myself went on Monday, a week ago, to Elmira to examine the Smead system of heating, ventilating and dry closets in use in the public schools of that city. The first building we visited was heated by both the Smead and another system, the Smead system being in a new part which had been in use only a couple of months. There were four furnaces in this part, and I think eight rooms, with about three hundred scholars. The heating and ventilation were the most perfect I ever saw. The doors and windows were all closed, but the air was as sweet and pure as it could be and the temperature about 70°. We passed from this part of the building into that part heated by another system, and the change was apparent as soon as we entered. In one of these rooms a window was down at the top and in another the door was open, and yet the school smell was there. The committee were thoroughly satisfied, and so expressed themselves. The committee when selected were chosen with a view to having as conservative a committee as could possibly be chosen, and they were calculated to find all the objections there might be. The volume of fresh air pouring into the building was sufficient to change the air entirely in every part of the building at least four or five times an hour. After a thorough and most satisfactory examination of the heating and ventilating features of the system we went down to the basement to examine the dry closet arrangement. This to me was one of the most marvelous things I ever saw. There was not the slightest particle of odor to be discerned even within two feet of the droppings in the vault, no disinfectants of any kind were in sight, and the entire droppings of three hundred children for six weeks would not fill a half-bushel measure. The urinals were as clean and devoid of smell as the closets, although they stood out on the open floor and were not enclosed. We visited another building and saw its operations there, and the result was precisely the same, and the testimony of the principals of both buildings was alike and in favor of the Smead system. I have never seen anything to compare with it, and I wish it could be introduced into all our school buildings. I forgot to mention that in some of the furnaces they were using pea coal with best results. Mr. Walter took all the tests of passage of air and can give you them if he chooses. We tested it at the intake, dry closets (seats and vaults) and rooms.

Yours truly, EZRA H. RIPPLE, *Mayor*.



Locke & Trowbridge Lith. Toledo, O.

STOVE HEATING.

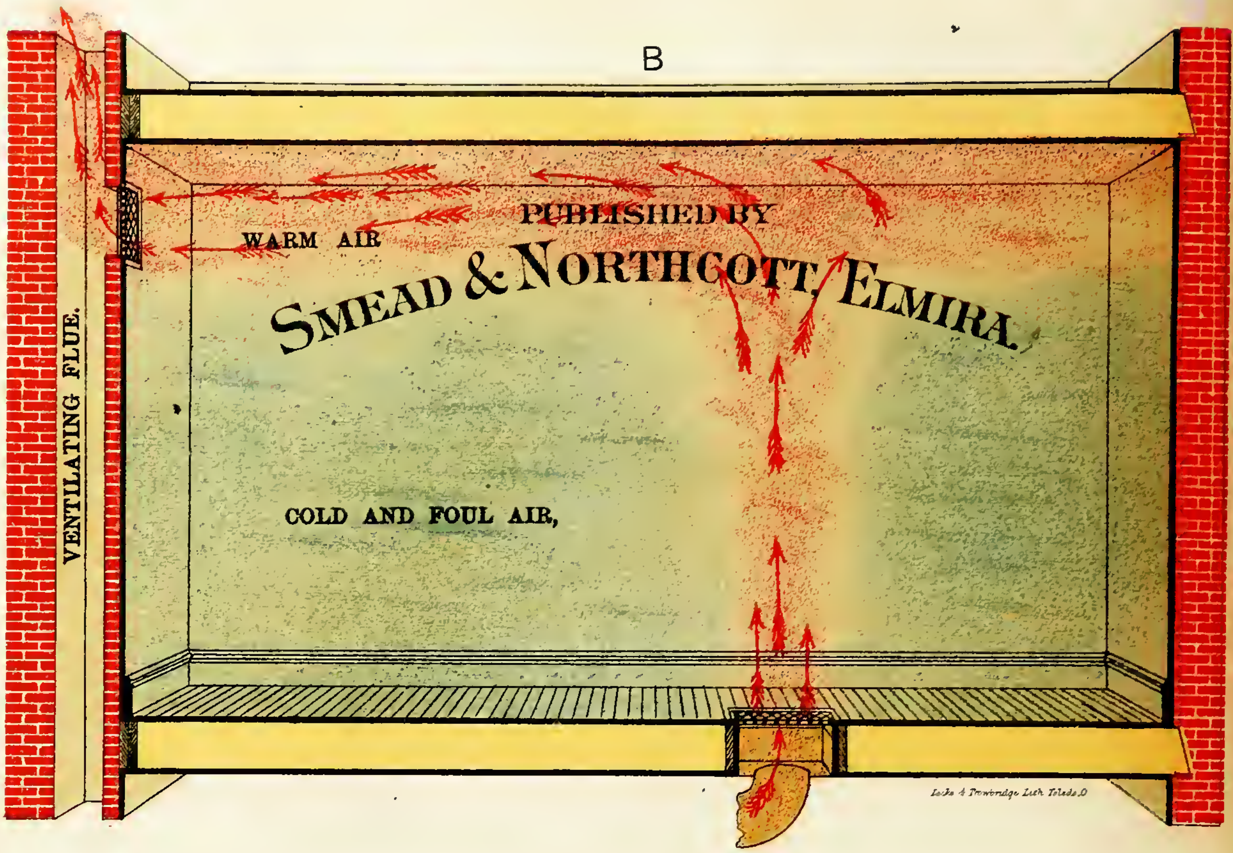
Mr. Smead: I told you yesterday that I would show you some cuts representing the condition of air under various temperatures. Here is a picture I have made to illustrate in colors the information you would get if you should locate at as many points a dozen thermometers in a room warmed by a stove or by direct radiation from a steam coil, the red representing the warm and the blue the cold air. The lady is busy and becomes too warm, and to "cool off the room" has opened the window, and at once a stream of cold air rushes in, which, being heavier, falls to the floor. The child playing on the floor has the croup that night. The lady tells the doctor that she "don't understand why it should," for "it was in the house all day, and the house was very warm." The truth is that the child "caught cold" because it was in the current of cold air that was traveling from window to stove. Many school children have become injured for life because in a room heated by direct radiation, either from a stove or a steam coil, someone having opened a window allowed a stream of cold air to drop upon them.

Normal, Ill., March 1, 1889.

Isaac D. Smead & Co., Toledo, Ohio:

Dear Sirs,—In regard to the furnace you set for us last fall, I write to say that we are more than satisfied; we are *delighted.* The only trouble we have had is to keep from making too much fire. The temperature is even and delightful all over the house. We are especially happy in having father's and mother's room so nicely warmed. Every winter before they have had to move into the back parlor because we could not heat their room. We want to thank your superintendent for his kind and careful attention while introducing the apparatus. After the furnace was finished and ready for use mother was carried down cellar. She had not been down for more than four years before. She was very much pleased with the looks of things; she thinks the front of the furnace too handsome for a cellar, it would almost do for a parlor ornament.

Very truly yours, Flora Pennell.


B
WARM AIR
PUBLISHED BY
SMEAD & NORTHCOTT, ELMIRA.
VENTILATING FLUE.
COLD AND FOUL AIR,
Locke & Trowbridge Lith. Toledo, O

THE POPULAR MISTAKE.

Dr. ——— : But many people seem to think that warm air must be bad air.

Mr. Smead : The *temperature* of the air is not an index of impurity ; it is upon the theory that warm air is bad air that has caused people to ventilate (?) their rooms at the top, as this cut illustrates, and that is what may be called the popular mistake. *Owing to the commonly mistaken belief that the breath rises, openings are generally made at the top of the room,* but *as they let all warm air out* and leave the occupied portions cold and foul, they are always closed in winter, and consequently such ventilation (?) has well earned the reputation of humbug.

REPLY FROM THE CHAIRMAN OF THE HIGH SCHOOL BOARD, CHATHAM, ONT.

Chatham, November 14, 1887.

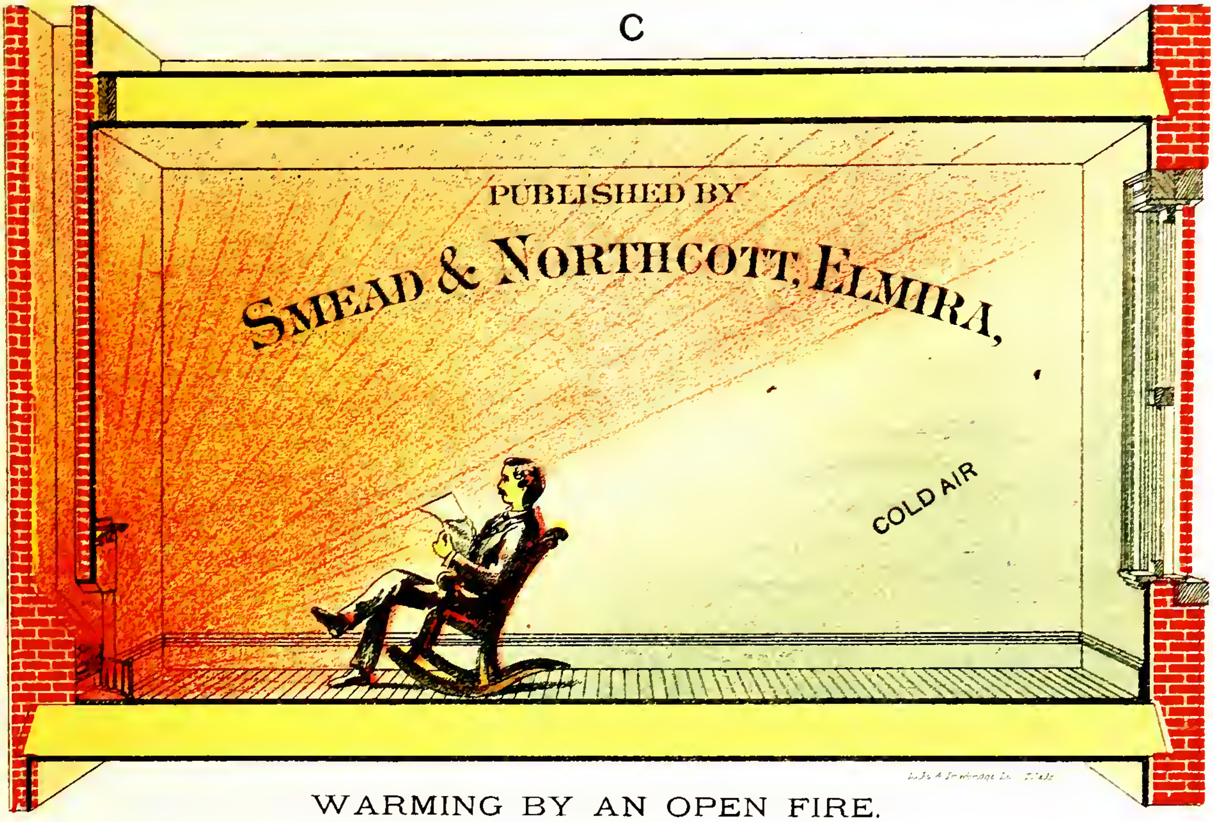
W. C. Wilkinson, Esq., Secretary Board of Public School Trustees, Toronto :

Dear Sir,—I found your letter awaiting me on my return from Toronto. In reply to your inquiries I beg to say :

1. The Smead system of heating and ventilating and their dry closet system were introduced into our new Collegiate Institute building erected last year, and have been in constant use since the opening of the school in January last. The results have been all we expected. Our eight schoolrooms, corridors and a large assembly hall have been heated and ventilated in a most satisfactory manner.

2. The dry closet system has received my particular attention. I have personally observed it in actual operation almost weekly since January last. It has in our school given unqualified satisfaction. Neither in the schoolrooms nor in the closets themselves have any disagreeable odors been perceptible. The closets were cleaned out in the summer by sprinkling a little coal oil on the excrement. The whole was then consumed with no trouble by fire, leaving a small residuum of ashes. We keep a small fire in the ventilating furnace when there is no fire in the heating furnaces. The introduction of this closet system solves, in my opinion, a very difficult problem. I have seen criticisms of it recently in one of the Detroit newspapers. All I can say is that our experience is wholly at variance with these criticisms. I will be pleased to answer any further inquiries, or I refer you to our principal, Mr. J. D. Christie, E. W. Scane, W. H. Stevens, or S. T. Martin, the three latter forming with myself our building committee. Truly yours, A. Bell, *C. C. C. I. B.*

C



PUBLISHED BY
SMEAD & NORTHCOTT, ELMIRA,

WARMING BY AN OPEN FIRE.

Mr. Smead : Here is another humbug illustrated, so far as *warming* is concerned.

Dr. ——— : What have you here ?

Mr. Smead : A representation of a room warmed by radiant heat from an open fire. You will notice that the man reading has already raised up one foot out of the cold. By and by he will want to turn around and warm his back.

Dr. ——— : I have always thought there was a great deal more sentiment than sense in some of the poetry and prose written about the "open fire."

Mr. Smead : The much admired open fire is only for the *eye*, and is all right if there is a large register somewhere in the room through which there can flow a large volume of warm air, and the volume must be considerably larger than the capacity of the fireplace flue.

Dr. ——— : Why ?

Mr. Smead : Otherwise the fireplace will "draw" cold air into the room through every opening it contains, even through the keyhole. This cold air falls to the floor, diffuses along over it toward the hot fire, and the occupants of the room suffer from cold feet.

Dr. ——— : That makes more business for the doctors.

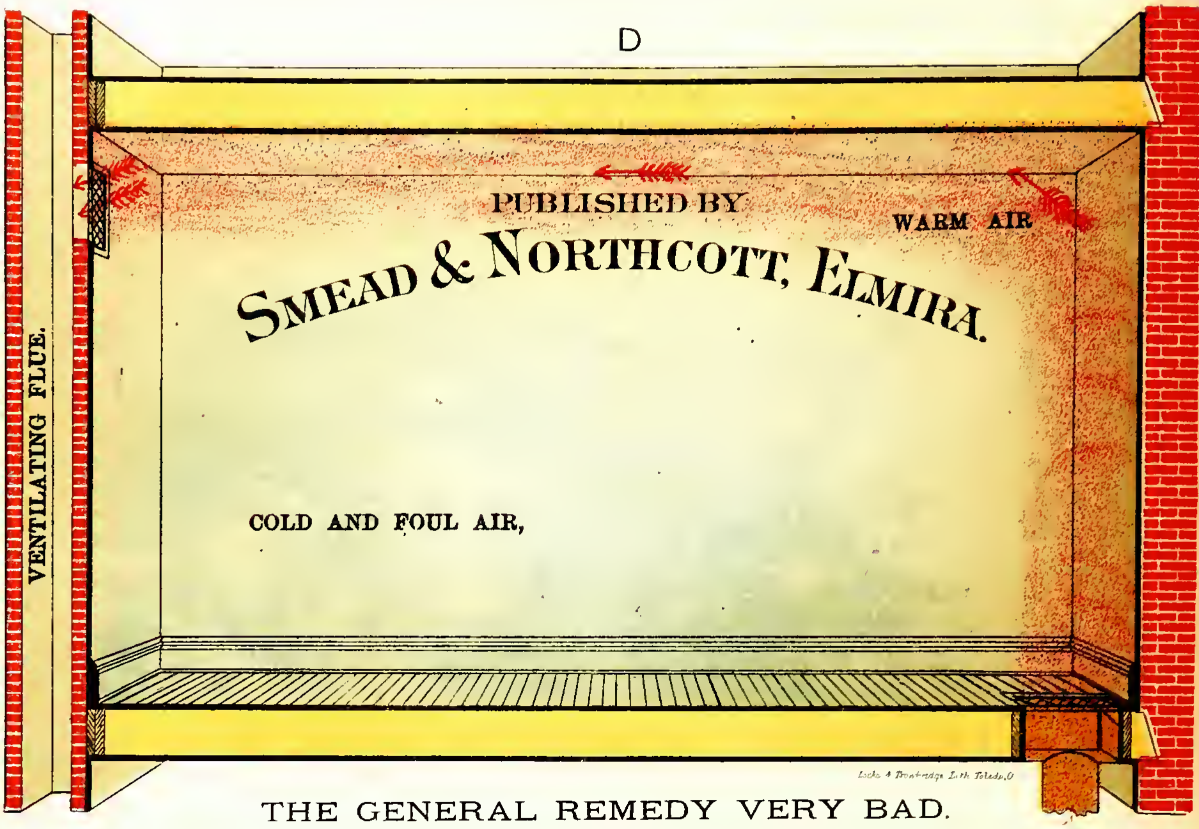
ITHACA, N. Y., January 27, 1886.

ISAAC D. SMEAD & Co., Toledo, Ohio:

Gentlemen,—Your system of heating and ventilating, which has been in use in our new High School building since the 1st of September last, proves in every respect to be most satisfactory. During the extremely cold weather a short time since, when for a full week the thermometer every morning ranged from zero to 10° below, the temperature of our schoolrooms at 9 o'clock was in every instance up to 68° or 70°. We appreciate your method of passing the foul air under the floors, whereby they are kept moderately warm. *Our pupils no longer suffer from cold feet in the schoolrooms.* The ventilation of the rooms is excellent; indeed, I hardly see how it could be improved.

I cheerfully recommend your system of heating and ventilating as superior for public buildings to anything before the public.

Very truly yours,
L. C. FOSTER, *Sup't of Schools.*


D
PUBLISHED BY
SMEAD & NORTHCOTT, ELMIRA.
WARM AIR
VENTILATING FLUE.
COLD AND FOUL AIR,
Locke & Trowbridge Lith. Toledo, O

THE GENERAL REMEDY VERY BAD.

Mr. Smead: So it does; but here is a picture representing a condition that will aid the doctors and injure the people more; it represents a condition that I have often found to exist. The register at the top is closed, and as the warm air cannot come in except the same amount of the air in the room goes out of it, the air already in the room goes down the cooler side of the register and is warmed over again. The people breathe it, it goes to the furnace, is warmed, the people breathe it again, it is warmed over again, and after several such revolutions it becomes fit only for the sewer.

New Lexington, June 8, 1886.

Geo. W. Keely:

Dear Sir,—In reply to your letter of inquiry as regards the Smead heating and ventilating, would say we have had but little experience as yet, but are well satisfied with what experience we have had. It has not its equal for heating and ventilating.

We did not go it blindly, but sent a committee to see and investigate the matter thoroughly. The committee visited several large school buildings heated and ventilated by this system, and came home convinced it would do all claimed for it. They found that any room in the building could be well ventilated without opening the doors or windows, while in the building in which steam was used the doors and windows had to be thrown open to secure the needed ventilation. Our committee made an arrangement with the janitor of one of the buildings visited to wait until they could be present in the morning before starting the fire. On their arrival they found the thermometer in the schoolrooms stood at 59°, and in just seventeen minutes from the time the fire was lighted the thermometer showed 70°. They also investigated dry closets, and found them just as represented by Mr. Smead's agent.

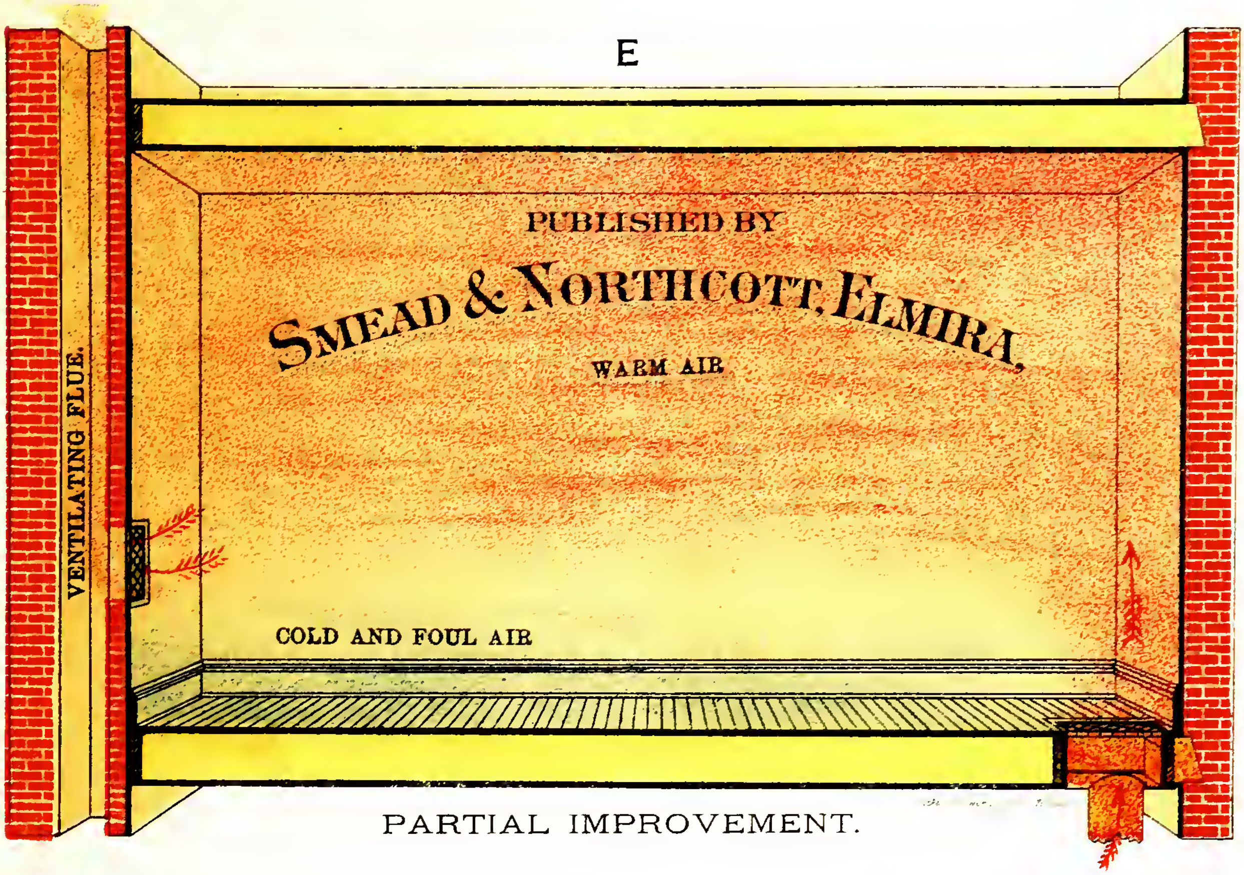
I am interested in our schools of Ohio, and wish to see the ventilation of our schoolrooms improved; and I am confident we have filled a long-felt want in the adoption of the Smead heating and ventilating system.

I am authorized by our Board to say they freely and gladly recommend this system as complete, and *just what every school building should have.*

Yours very respectfully,

W. T. Meloy,

Clerk of Board of Education.



PARTIAL IMPROVEMENT.

Dr. ——— : What does this represent ?

Mr. Smead : The position of the warm and cold air with the exhaust register a few feet off the floor. I was recently called to examine a church that was "uncomfortable" in the winter. I went to the building (an old one) with the pastor and a number of the building committee. The pastor said he could "not understand why the people complained. We have four large furnaces, and it always seems warm enough in the pulpit." The trustee remarked that they couldn't "all occupy the pulpit" and that it "is cold down among the pews."

Dr. ——— : What was the matter ?

Mr. Smead : The room was supplied with at least twenty exhaust registers, about ten on a side, and all located as you see represented in the picture, about four feet from the floor. The people were in a strata of air twenty degrees colder than that occupied by the preacher.

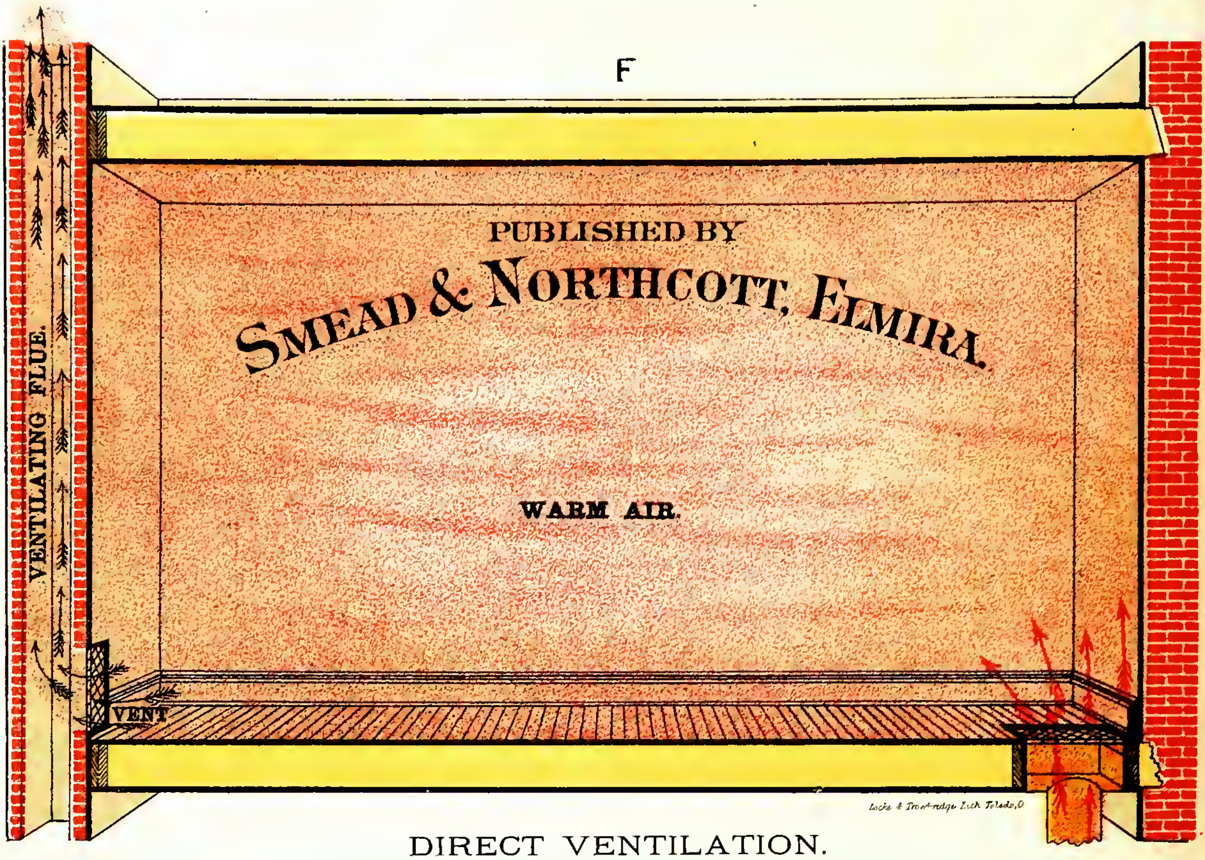
Dr. ——— : What did you do ?

Mr. Smead : Explained to them the cause of the trouble ; they stopped up the so-called "ventilators," cut some holes in the floor, built boxes connecting the audience room with the four furnaces, and produced the condition shown in the previous cut, namely, changed from a condition of cold air to "warmed-over air," and I lost my time and expenses of the trip.

Glens Falls, N. Y., August 17, 1886.

Charles H. Peck, Sup't Buildings, Worcester, Mass. :

Dear Sir,—Our central building is heated and ventilated by the Smead system. We have occupied the building something more than a year, and to say that we are fully satisfied is putting it very mildly. With the thermometer 30° below zero we had no difficulty in warming the whole building within an hour from starting the fire. The ventilation is so good that in coming in from out of doors the only difference you would notice would be in temperature. The space heated, exclusive of basement, is 175,000 cubic feet. The cost for the year—burning wood—was $271.89. The cost with soft coal would perhaps have been a little less. After all, the best thing of all is the dry closets. Should you wish any further information, I shall be glad to give it. Very truly yours, Sherman Williams, *Sup't Schools.*


F
PUBLISHED BY
SMEAD & NORTHCOTT, ELMIRA.
WARM AIR.
VENTILATING FLUE.
VENT
Locke & Trowbridge Lith. Toledo, O

DIRECT VENTILATION.

Dr. ——— : Why didn't they change the location of the registers to a point on a line with the floor, as you show in this drawing?

Mr. Smead : They could not do so without great expense, as the wise architect had commenced the flues at that point. The hot-air furnace man had taken all their money for the work he had done, and they had no more with which to secure a complete system. This cut I have last shown you represents direct ventilation, and is correct in principle. The plan can be built into buildings already constructed, and successfully, too, *provided there is someone in charge who knows how to do it.*

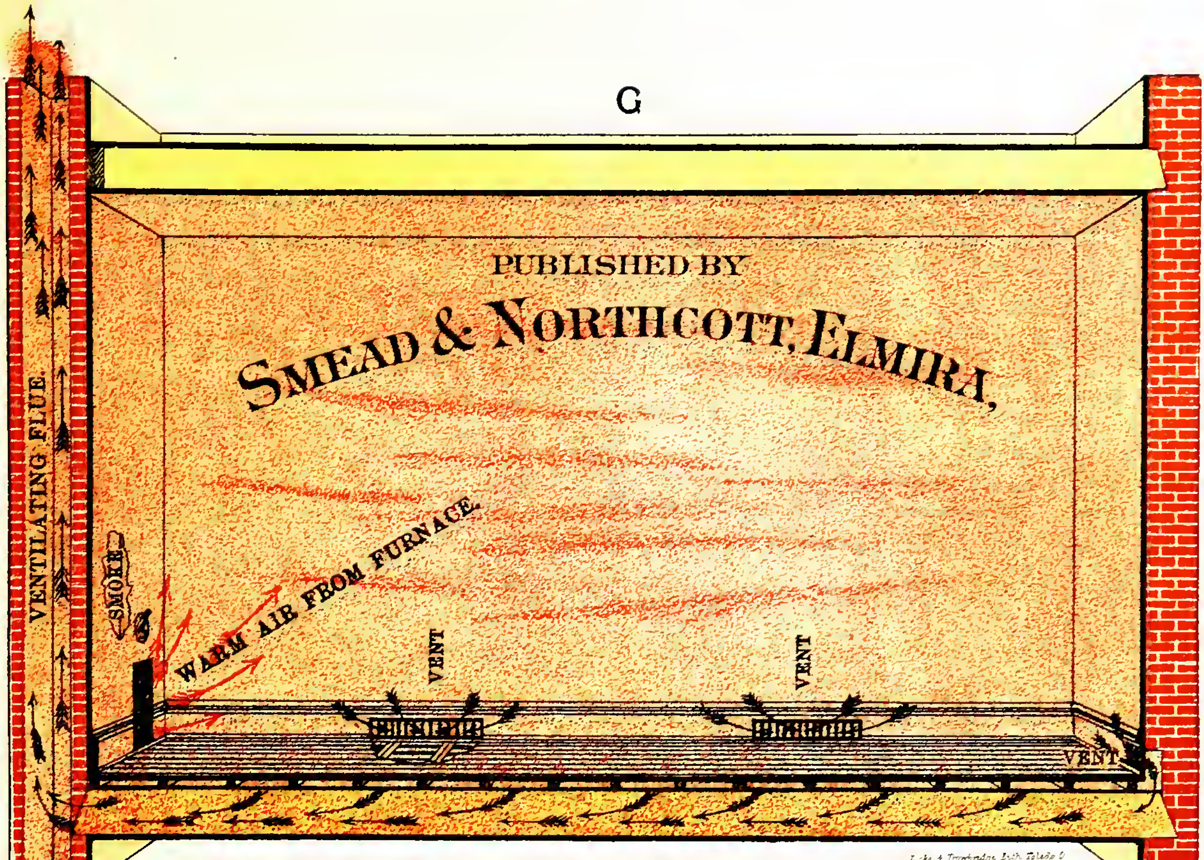
Dr. ——— : This seems to represent some of the work I have seen in one of our public school buildings.

Toronto, Ont., March 22, 1889.

Dear Sir,—In reply to yours of the 11th, would say that the Toronto Public School Board sent a deputation of five (and I accompanied them) to visit the leading cities of the United States, for the purpose of gathering the latest and best improvements in heating and ventilating school buildings. The committee returned home last night (hence the delay in answering your letter), having visited nineteen cities, and they are unanimous in the conclusion that the Smead system is the best and cheapest in use. We found two schools heated by steam, direct and indirect, that were, perhaps, as well ventilated as if by the Smead system, but the cost was about twice that of the Smead.

We have in Toronto the Smead furnaces in twelve of our schools, and the dry closet system in nine of them, and they have proved very satisfactory. In view of the fact that we propose building nine new schools and enlarging ten others, and the Board being specially anxious that the schools be well heated and ventilated, was the reason for sending the deputation, and they have come to the conclusion that the Smead system is the best, and I indorse that opinion. There was considerable opposition to it at first, but after two years' experiment with it in some of our schools the opposition faded away. Should you wish my opinion on any of the details of the system, I will be pleased to answer any questions you may ask.

Yours truly, C. H. Bishop, *Sup't of Buildings.*



CORRECT AND COMPLETE SYSTEM.

Mr. Smead: Yes, in the old buildings; but in the new ones I exhaust the air upon a much better plan. Examine this drawing. You will notice that by the use of furring strips laid across the joists upon which the floors are placed, between the floor and the plastering of the ceiling below, a space is formed and air can freely pass either over or between the joists. I place the exhaust registers at several different points around the room, through which the air can pass to space under the floor, thence into ventilating flue.

Dr. ——: This must prevent strong local currents such as you must have with the direct ventilation.

Mr. Smead: Yes, and at the same time warms the floor, as after the air becomes heated the air going out is warm, the floor absorbs almost all the heat it contains before it reaches the stacks. Another advantage is, that with this plan, one ventilating flue can be made to do duty for several rooms if properly located and of proper size.

Dr. ——: Not much chance for cold feet in a room constructed as you represent here.

Mr. Smead: No; and that is one reason why the doctors' bills among school children in Toledo have been so much reduced. You may remember that I called your attention to that when you were in a few days ago.

Cleveland, Ohio, April 20, 1889.

Isaac D. Smead & Co.:

Gents,—Your heating apparatus and dry closet system is, in my opinion, the best the city of Cleveland ever had in our public schools. It is far superior to sewerage and steam heating which is used in some of our school buildings at the present time. Had I alone the power I would discontinue the old system and place your apparatus and dry closet system in their stead. As to the *Leader* articles condemning your system, pay as little attention to them as possible. They are liable to write all kinds of trash about a person. I suppose if you had "greased" them your system would have been the best in the land.

Very respectfully, Ph. Voelkle, *Ex-member of the Board of Education.*

Mr. Smead: We spent some time yesterday examining the pictures I made representing air in its various positions, and I tried to show you that the position it occupies is governed almost entirely by its temperature. If I am correct must it not follow that *successful warming and ventilating depends upon the skill of the engineer in so arranging his plan that, with the lowest degree of temperature comfortable, the best results may be obtained?*

Dr. ——— : Why do you say "with the lowest degree of temperature"?

Mr. Smead: Because, except such degree of warmth as we may get from the sun, all other heat is secured at an *expense*—at a cost of dollars and cents, and that, too, in several directions, namely, cost of apparatus, cost of fuel and cost of attendant to care for apparatus and supply the coal.

Dr. ——— : I understand that you claim to have reduced all to the lowest point possible.

Mr. Smead: Perhaps not to the lowest point it will ever go, but we have reduced it to the lowest point up to this date, and I am at a loss to understand how it can be taken much lower.

Dr. ——— : Do you reach low tide in every building?

Mr. Smead: By no means.

Dr. ——— : Why?

Mr. Smead: There are many reasons why. There are no two buildings exactly alike, and it is not possible always to apply all the rules to every building. It would be if we could have the entire and absolute arrangements from commencement to completion. When this is done we *always* strike the *low point.*

Dr. ——— : During one of our first interviews you convinced me that your warming apparatus is correctly constructed to get the best results from the fuel used. What features do you consider next in importance?

Mr. Smead: No less important than the heating apparatus is correct engineering or arrangement of cold and warm air flues, location of the apparatus, a faithful execution of the engineer's plan, and care of apparatus after it is turned over to the customer.

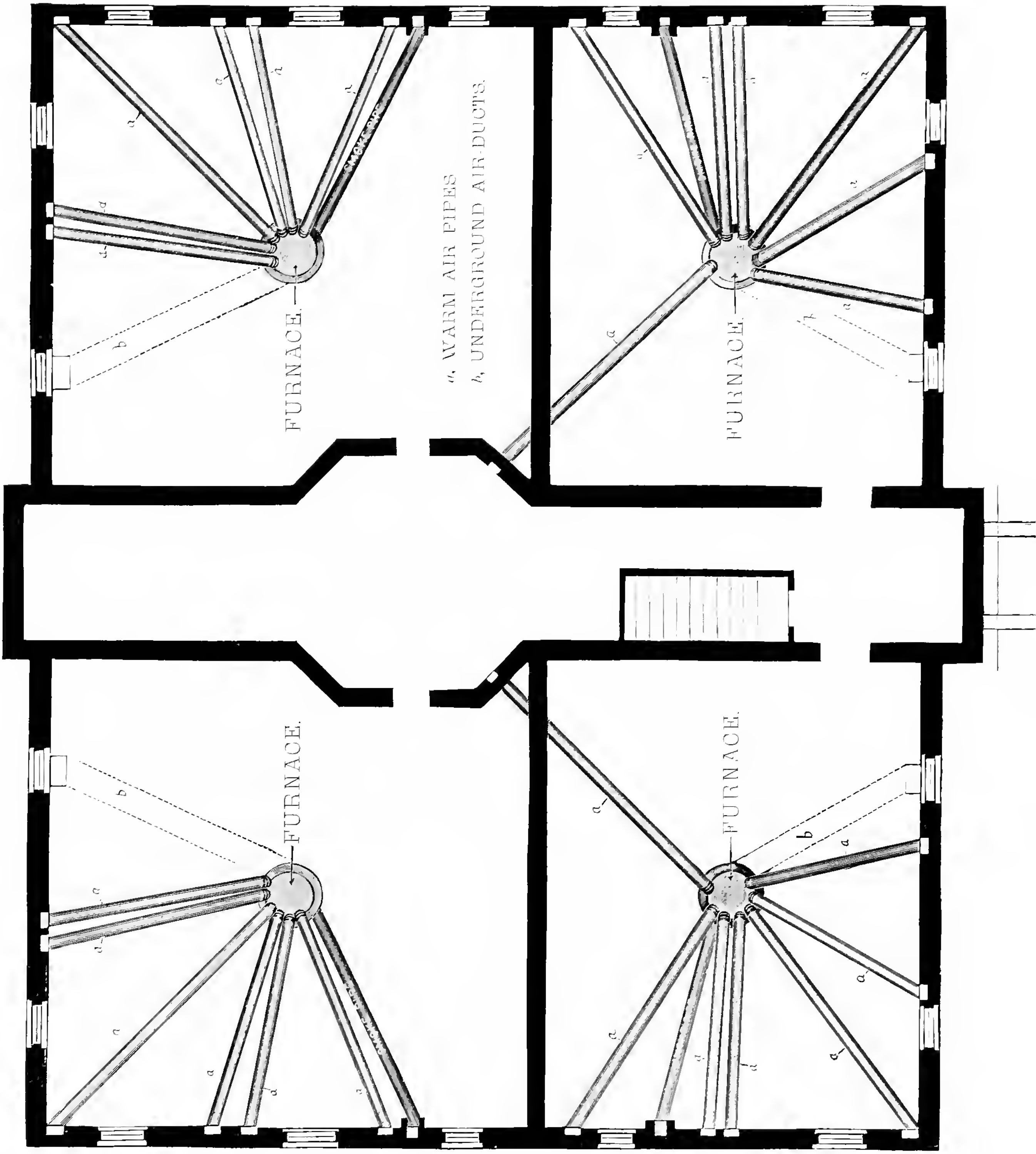
Dr. ——— : I wish you would show me a job of poor work, and then show me the same work properly arranged.

Mr. Smead: Come in tomorrow and I will.

* * * * * * *

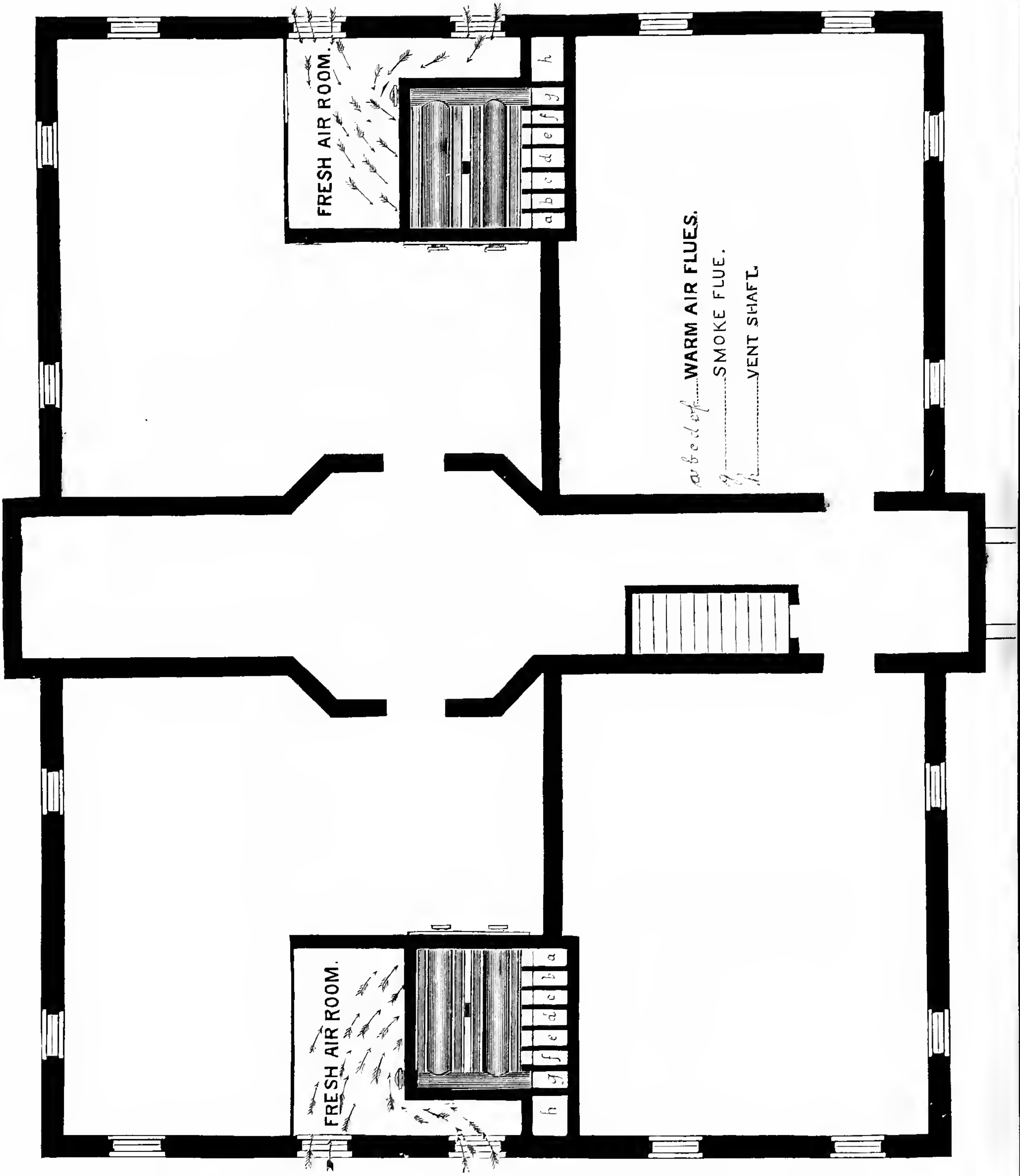
Mr. Smead: Good morning, doctor; I told you yesterday that I would show you two kinds of engineering. Here are some pictures that fairly represent the ideas I wish you to understand. (See cuts pages 47, 48 and 49.)

In 1882 I was requested to submit an estimate to furnish warming and ventilating apparatus for a school building in Youngstown, Ohio. I was informed that there were already in the building "hot-air furnaces," and that "the only warm portion of the building during cold weather was the basement," and that was too warm; that about "one hundred tons of hard coal were burned annually," and schools were dismissed because of cold schoolrooms very often each winter; that "board were prejudiced against furnaces." Upon examination of the building I found exactly what I have seen many, many times before, namely, *small furnaces*, *small warm-air pipes*, *small warm-air flues*, the basement room *spoiled* for any other purpose than for fuel and the "hot-air traps," which some inexperienced hardware dealer, or some traveling "salesman" who sold furnaces on a commission, had sold the board. They could not be used for play-rooms or for janitor's quarters, and what was *worse*, there were *no ventilating flues in the entire building;* the air of the schoolroom was *simply horrible.* (On page 47 I represent a basement plan of the building as I found it.) A careful measurement showed *570 feet of warm-air pipe.* (On page 48 I represent the plan I presented for the consideration of the board.)



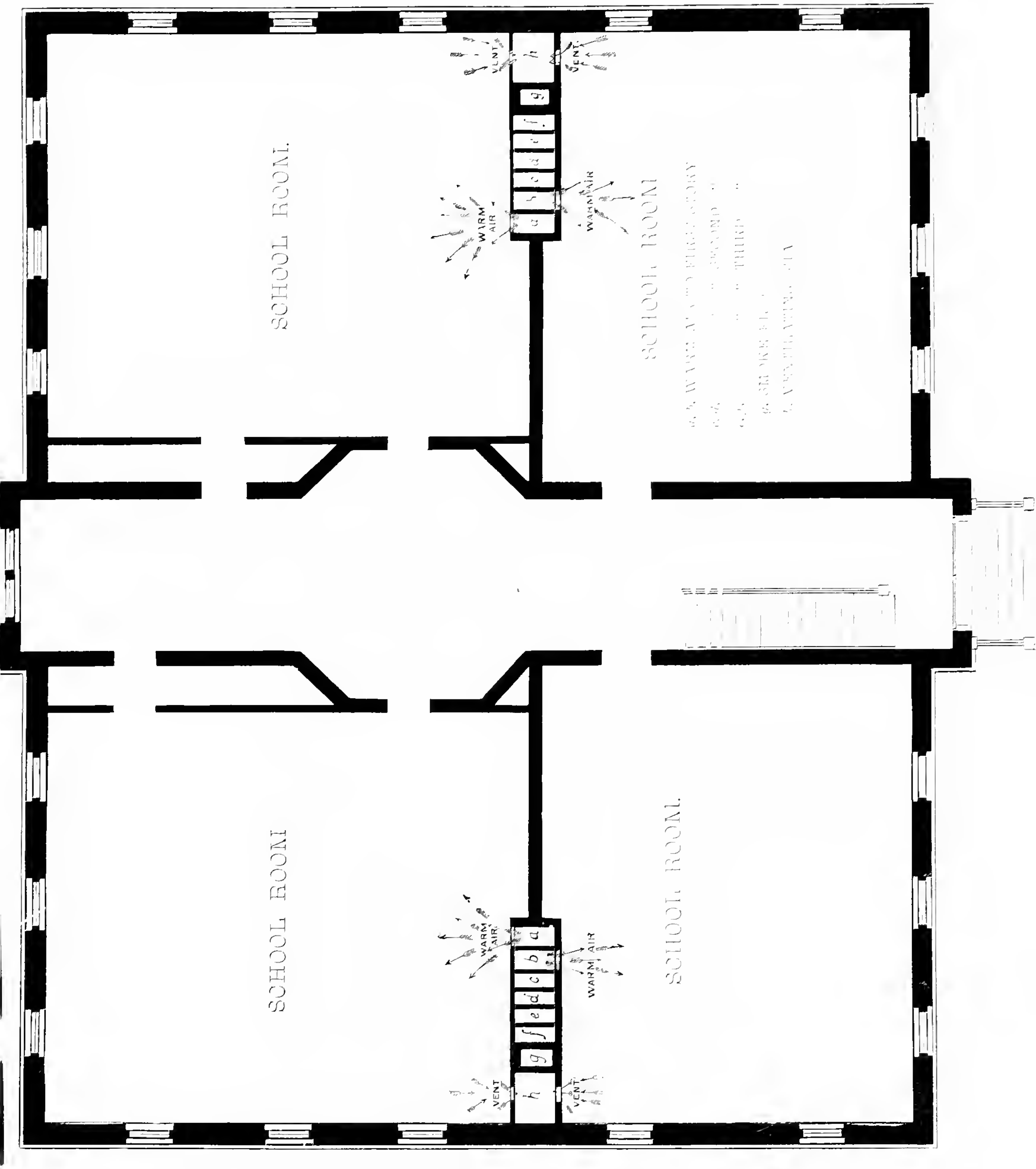
BASEMENT PLAN OF SCHOOL BUILDING, YOUNGSTOWN, OHIO.

Showing application of "Hot-Air" System of Warming. For explanation, see page 46.



BASEMENT PLAN OF SCHOOL BUILDING, YOUNGSTOWN, OHIO.

Showing application of Smead System of Warming. See page 50.



PLAN OF FIRST STORY OF SCHOOL BUILDING, YOUNGSTOWN, OHIO.

See page 50.

A glance at each must convince anyone that the latter is the more simple.

With the *first*, the basement rooms are spoiled.

With *mine*, only a small portion is occupied by apparatus.

With the *first*, four fires must be built during fall and spring months.

With *mine*, only two fires are necessary during the fall and spring months.

With the *first*, there is a large expense for long, horizontal tin pipes.

With *mine*, there is not a *foot* of tin pipe used.

With the *first*, there was a *small, damp, underground* cold-air box, to be filled with rats, dead cats, water and rubbish that always collect around a school building.

With *mine*, a COLD-AIR ROOM that can easily be kept clean.

With the *first*, there are in the building (built into the walls) small, *tin* warm-air flues that are *expensive* and *difficult to introduce*.

With *mine*, large brick flues closely connected with the warm-air chamber.

With the *first*, the air is conveyed a long distance horizontally.

With *mine*, the warm air only has to *rise*, which it must necessarily do, *up* the large flues. On page 49 I represent the plan of first story, showing location of warm air, smoke and ventilating flues. Arrows represent entrance of warm air and exit of foul air. My guarantee was: the temperature should be nearly *the same in all portions of the room*; that the variation should not exceed *two degrees*, and that *the entire building could be warmed within two hours after fires were lighted*. Notwithstanding the *simplicity of my plan*, and our *strong guarantee*, the *prejudice* of the board against furnaces was so strong that *my bid was rejected*, and steam-heating apparatus was introduced. During the summer of 1883, one year later, the board, after using the steam apparatus in the building referred to one winter, with a vacation of two weeks for repairs to apparatus, contracted with me to furnish heating apparatus for two school buildings, and the following letter, written by the superintendent of Youngstown schools to superintendent of Ithaca, N. Y., schools, gives evidence of the result:

YOUNGSTOWN, O., January 29, 1884.

Superintendent L. C. Foster, Ithaca, N. Y.:

DEAR SIR,—Your favor received. In answer, would say that we have tried about every kind of heating apparatus, and prefer the "Smead system of heating and ventilating" to anything else, in respect either to *heating, ventilating* or *economy*. We expect to put it into two additional buildings next summer. Some of our teachers who taught last winter in a building heated with steam say that "there is no comparison." One says the change to Smead system has *certainly improved her health*.

Very truly, etc., R. MCMILLAN, *Superintendent*.

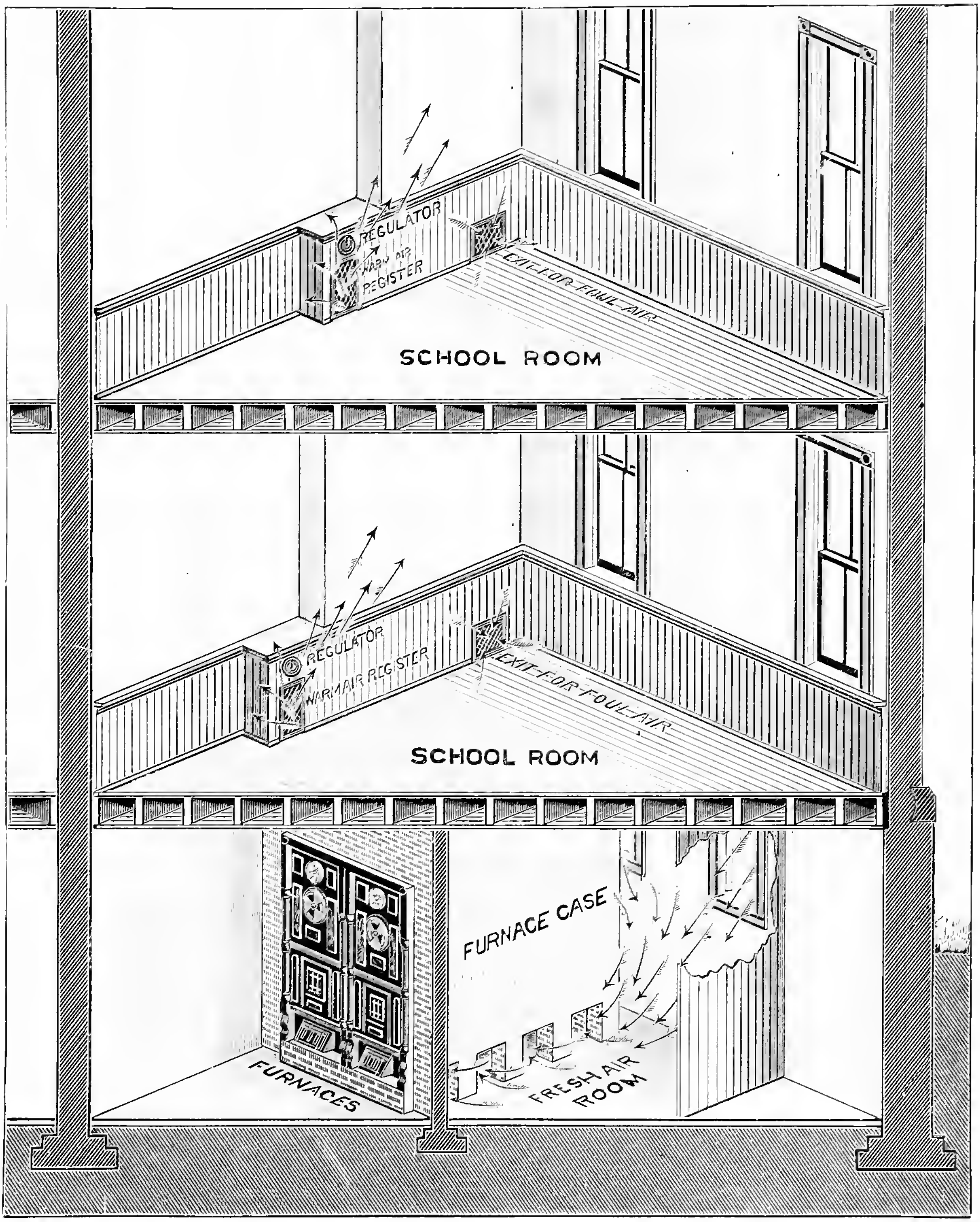
I will simply add that during the summer of 1884 the Youngstown Board introduced our apparatus in two more school buildings, and refer to W. N. Ashbaugh, Esq., secretary of the Board, for such other information as the reader may desire.

Dr. ———: I understand the difference now, and it seems that the Youngstown Board did too.

Mr. Smead: Yes, and so have hundreds of other school boards been taught some lessons during the past few years. Tax payers would be saved a large amount of money if the lesson were learned earlier.

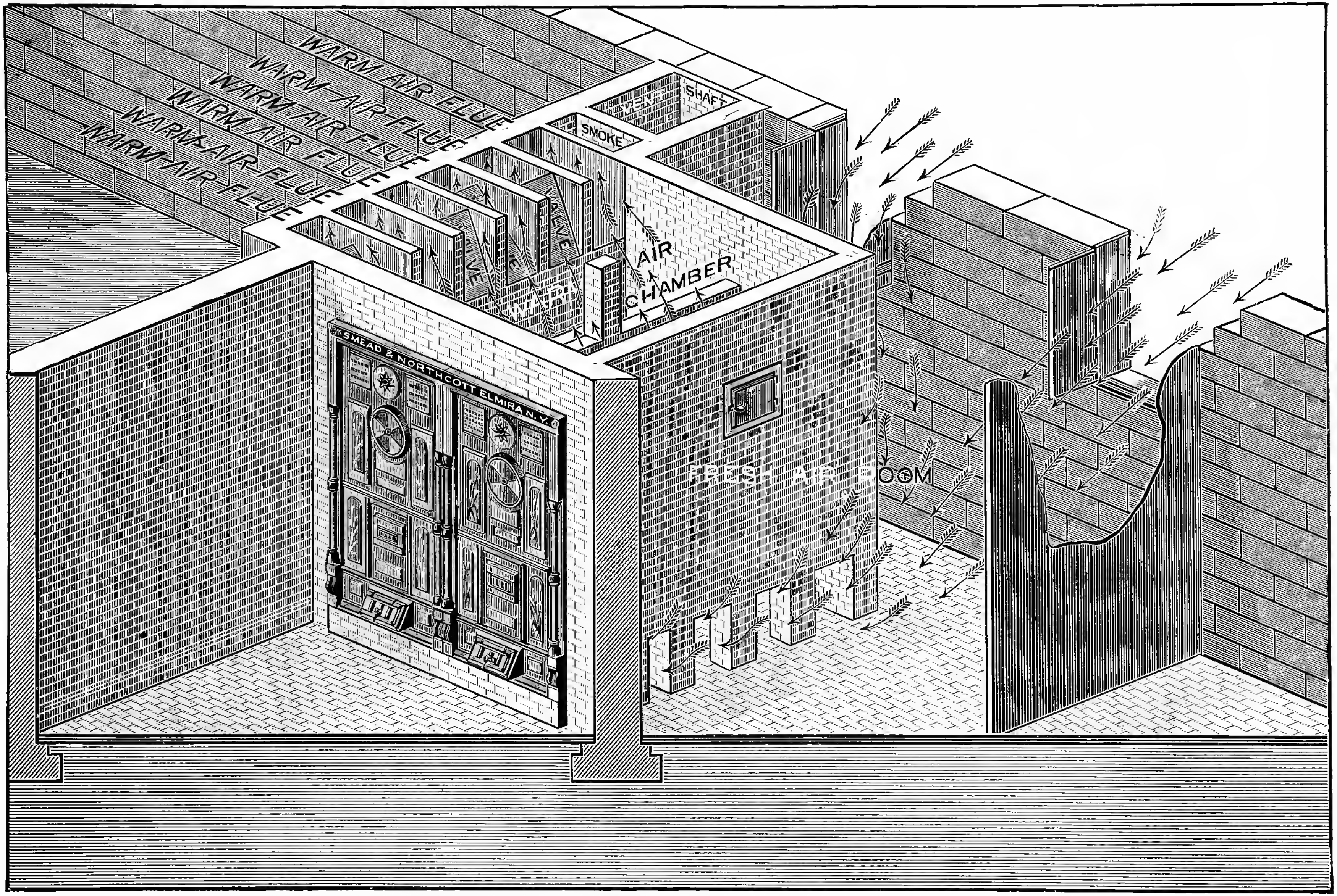
Dr. ———: Does our system of constantly changing our public officers affect the situation?

Mr. Smead: It works both ways. I don't know how it could be improved. Take the Youngstown case to which I have just called your attention. I presume there is not a member of the present Board who knows anything about the trouble the Board had previous to 1883, or who knows much about the present apparatus; and the chances are that the janitors know less. There is no one finding fault, and the engineer who *succeeded* is forgotten. If he had failed, the Board and all the patrons of the school would have been yelling themselves hoarse to find him, and the press would not charge him $1 per line for the advertisement of the fact; and stove dealers and steamfitters would be sending marked copies of the papers all over the country with the kindly effort to save others from similar danger.



PERSPECTIVE VIEW.

Showing Air-Warmers, Cold-Air Room and First and Second Story Registers of plan referred to on page 50.



PERSPECTIVE VIEW OF YOUNGSTOWN PLAN.

Showing arrangement of Flues, Valves and Air-Warmers.

(See pages 49 and 50.)

Dr. ——— : You have referred several times to steamfitters and plumbers, but have said but little about steam-heating apparatus. There are many who seem to prefer steam apparatus to hot-air furnaces.

Mr. Smead : So there are, or rather there *were;* and as against the "hot-air furnace" system, I should prefer steam myself if I could afford it.

Dr. ——— : Is steam apparatus more expensive than hot-air furnaces ?

Mr. Smead : Very much more expensive.

Dr. ——— : How does the first cost of the plant compare with the cost of yours ?

Mr. Smead : A first-class steam-heating apparatus costs about twenty-five per cent more than the Smead apparatus. Prices for steam-heating apparatus are something like values on horses. You can buy a horse for $40 or $400 ; only the thoroughly posted can tell the difference — until they use them. Here is a list of bids recently submitted on a $400,000 building :

Steam heating	$24,000.00
" "	6,127.00
" "	17,955.23
" "	7,525.00
Isaac D. Smead & Co., "Smead apparatus"	26,890.00

Dr. ——— : Who secured the contract ?

Mr. Smead : Isaac D. Smead & Co.

Dr. ——— : Why was there such a variation in prices ?

Mr. Smead : The low bidders did not consider the question of ventilation at all, and the high bids were "wild bids," submitted by firms exceedingly anxious to "down" us. Firms accustomed to execution of large contracts, and who do strictly first-class work, did not bid at all.

Dr. ——— : What would have been their price if they had bid ?

Mr. Smead : On the basis of prices for the class of work done in government buildings, where every effort is made to get the best, the price on the building I have mentioned would have been from $35,000 to $40,000.

Dr. ——— : You refer to cost of apparatus.

Mr. Smead : Yes, set and ready for use.

Dr. ——— : You admit that a building can be both warmed and ventilated by steam apparatus ?

Mr. Smead : Certainly I do. I will further say that almost any steamfitter can put in a boiler and pipes enough to get a building *hot.*

Dr. ——— : But greater skill is required if ventilation is considered ?

Mr. Smead : Very much ; there are not a score of engineers in the United States who thoroughly understand the business, and they generally introduce some plan of mechanical ventilation.

Dr. ——— : What are your objections to use of steam in, for instance, a public school building ?

Mr. Smead : I am often asked that question, and recently where a contract was pending and my statements were to be answered by a steam-heating engineer, I submitted twelve reasons why steam apparatus was inferior to ours. I could have given more, but "rested" on twelve. Here they are :

1. Because the *first cost of the Smead is from one-third to two-thirds less* than for first-class steam heating.

2. Expense for fuel is from *one-third to three-fifths less.*

3. Expense for *janitor* to care for the Smead is about one-half less than for *engineer* to care for steam apparatus.

4. *Thorough ventilation* in a schoolroom cannot be secured with steam apparatus at anything like a reasonable cost, and is not secured *at all* where direct radiation is used, and *never*, either with direct or indirect, *when temperature outside of building is 12° below zero.*

5. There is no possible *danger from explosion* with the air-warmers, while with steam there is *constant danger*, whether the pressure be "high" or "low."

6. There are *no water pipes to freeze, burst, and let water all through the building*, ruining plaster and furniture.

7. Repairs for steam boilers, pumps and pipes *will cost in ten years ten times as much as for the Smead*, and must always be made by a skilled steamfitter, while any janitor who is competent to sweep a room can replace broken or worn-out castings in the air-warmers.

8. The Smead will warm and ventilate a building *during any kind of weather, no matter how hard the wind blows or how low the mercury, while steam contractors will seldom guarantee with mercury 12° below zero.*

9. The Smead air-warmers are set in connection with *strong and important patents, on a plan of ventilation* that no steam contractor can use.

10. Because with the Smead a building *can be warmed in one hour from the time fires are fairly burning*, while from four *to six hours are required with steam apparatus.*

11. *Three-fifths* of the force generated by the burning fuel in steam apparatus is lost in the form of mechanical motion, and does not appear as temperature in the rooms, while with the Smead *seven-eighths* appears in room as temperature, and *one-eighth* only is lost.

12. With the Smead absolute *uniformity of temperature* can be secured throughout a building, while with steam-heating apparatus rooms a distance from the boiler are generally *from ten to fifteen degrees colder during cold and windy weather.*

Dr. ———: Who secured the contract ?

Mr. Smead : I did. We always do when the *actual facts* are fairly considered.

Dr. ———: Your indictments are severe.

Mr. Smead : I can prove every one to be a "true bill." Here are some items which I have just cut from a paper. I offer you these on the question of danger.

Fort Wayne, Ind , January 13.

St. Mary's Catholic Church, on Lafayette street, was entirely destroyed today by the explosion of the boiler of the steam-heating apparatus. The walls and tower are still standing, but by order of the Mayor and Council will be taken down at once to prevent further fatalities. Anthony Evans, the engineer, was instantly killed. He was in the boiler-room at the time, engaged in getting the church warmed, to have it *ready for about 200 school children, who were to attend services later in the afternoon.* Evans' remains were buried in the débris, and the firemen were over an hour digging them out. Alberta Williard, a school-girl of 12, had just left her father's house, near by, on her way to school, and had reached the front of the church when the explosion took place. One of the large entrance doors was hurled outward with great force, striking her on the head, killing her almost instantly.

The church was built about twenty years since, at a cost of $30,000, and improvements to the amount of $30,000 have been added, making a total loss of $60,000, on which there is an insurance of $24,000. There is some doubt expressed about it being collectible. The boiler was entirely new. The entire heating apparatus was put in last September. Pipes were distributed all over the church, and ran under nearly every pew, which caused the explosion to be a general one. *Parts of the boiler were thrown 200 feet in the air, and the explosion was felt over the entire city.—Chicago Tribune, January* 14, 1886.

A NARROW ESCAPE.

Our Milwaukee correspondent writes: What might have been a serious accident is reported here. The janitress of the 18th Ward School lit the fires when the steam boilers were empty. When they were red-hot she discovered her error and reported it to the principal, who insisted upon turning on the cold-water supply to the boilers against the better judgment of the woman, who thought it was dangerous to do so. The usual result followed, and the boilers are a total wreck. Had they not been sectional boilers, several lives would have been lost. It is very necessary to have competent men to take care of the steam apparatus in the schools.—*Exchange.*

Wabash, Ind., February 19, 1889.

Isaac D. Smead & Co., Toledo, Ohio:

Gentlemen,—Yours of yesterday received. In reply would say that our building is all that could be desired in an eight-room house. The heating is more than adequate; the ventilation is perfect. The dry closet system meets all requirements. Indeed, we are more than satisfied — we are well pleased; and when I say *we* I mean not only the school trustees but all of our people. Yours truly, J. H. Ford,

Sec'y of Board and Health Officer of Wabash County.

BLOWN THROUGH THE HOTEL.

DISASTROUS EXPLOSION OF A STEAM HEATER AT EAGLE BRIDGE.—MEN AND WOMEN SCALDED AND HURLED THROUGH WINDOWS AND DOORS INTO THE SNOW.—HALF A TON OF IRON THROWN INTO THE ROOM ABOVE, AND TWO LADIES DASHED TO THE CEILING THERE.—THE INJURED.

[SPECIAL TO THE WORLD.]

TROY, N. Y., December 22.

A boiler used for heating Dell Brown's Hotel, at Eagle Bridge, twenty miles east of here, exploded this afternoon with terrible effect. The severely injured are:

Dell Brown, scalded and blown through window.

Mrs. Dell Brown, cut, bruised and scalded.

Miss Ann Hagan, burned, bruised and nose broken.

Charles Kirby, blown through a door, and fell thirty feet distant.

Mrs. Charles Kirby, burned and both legs broken.

Cornelius McCann, burned and blown through window.

The explosion completely wrecked the waiting-room and a large portion of the hotel. The floor of the sitting-room in which Mrs. Kirby and Mrs. Brown were was blown to pieces, the women being lifted to the ceiling above and falling back among the wreckage. Both of Mrs. Kirby's legs were broken below the knees, her face was cut and her hands seriously burned. Her husband went to her rescue and pulled her out through a window onto a balcony. She is apparently the most seriously injured of all, although it is believed she will recover. Mrs. Brown was badly cut and burned about the face.

Dr. Hudson, of Hoosick Falls, was telegraphed for, and, with Drs. Shaw, Ridon, Ashton and Myers, attended the injured.

In the sitting-room the plastering was torn off and the furniture wrecked, a large piano being thrown completely over and broken. The top of the heater, which weighs half a ton or more, was thrown up into the sitting-room and is held there by steam pipes, which are bent and twisted. The boiler was placed in the hotel about a month ago. The cause of the explosion is unknown. Mr. Brown thinks it was from coal gas, but the prevailing opinion is that a stop-cock was turned off in an upper room, which caused the boiler to fill with steam and burst under the pressure.

FRIGHTFUL EXPLOSION IN A HOSPITAL.

LINCOLN, Neb., February 5.

At 3 o'clock this afternoon two boilers in the engine room of the State Hospital for the Insane exploded, completely wrecking the engine house, killing two patients, injuring two others, and the two engineers will probably die before morning.

Extract from last (1888) annual report of Board of Education, Washington, D. C.:

VENTILATION.

"The schoolrooms that have been provided during the last seven years are cheerful, thoroughly ventilated and healthful. I am glad to be able to say the system of ventilation employed ventilates—and ventilates in spite of the preoccupation of *the teacher or of the janitor. In respect of heating, lighting and ventilation, nothing more is to be desired* in the new buildings."

On the question of cost of fuel I ask you to examine this table, showing

COST OF WARMING SCHOOL BUILDINGS.

IN TOLEDO.

For Winter of 1884-5:

With Smead apparatus	$22.79	per schoolroom.
With steam-heating apparatus	52.68	" "
With hot-air furnace	86.25	" "

IN DETROIT.

With Smead apparatus (frame building)	$25.25	per schoolroom.
With steam-heating apparatus (brick building)	54.00	" "

IN WASHINGTON, D. C.

With Smead apparatus	$24.20	per schoolroom.
With steam-heating apparatus	56.00	" "

On the question of repairs, I refer you to the extract from the Columbus, Ohio, report (page 21). There are two school buildings in Columbus, both of the same size — twelve rooms. One is warmed with steam apparatus that cost, including closets, over $8,000 ; the other with mine, which cost, including closets, less than $4,000. The rteam apparatus is cared for by a skilled engineer. The one containing mine is entirely cared for by a janitor. During the winter of 1887 and 1888, 84 tons of soft coal were burned in my apparatus, and 168 tons used in the steam-heated building.

Dr. ——— : How about the question of exposure ; is yours less exposed to the wind ?

Mr. Smead : On the contrary it is very much more exposed, one being in the business portion of the city and the other (ours) almost out in the country.

Dr. ——— : In your eleventh objection to steam you refer to a loss of three-fifths of the force. Do you speak from practical experience or do you quote from Sewall ?

Mr. Smead : Both. Here is what Sewall says :

> *Another method of heating is by driving steam through coils of iron pipe. Not only does this method of warming render ventilation impossible, but it is, perhaps, the most uneconomical.*
>
> Now heat may manifest itself in two ways, namely, as temperature and as expansion. All the force generated by the burning fuel will appear in one of these forms, or a part of both. Water at the normal pressure can be heated to only 212° Fahrenheit. Consume as much fuel as you will, and the water will remain at 212° Fahrenheit; but the force generated by the consuming fuel is not lost, but is transmitted to the water in the form of expansion, and the water is converted into steam. Now, if the water be confined, and this tendency to expansion resisted, the temperature can be elevated to almost any extent; but if not thus resisted the temperature will not rise above 212° Fahrenheit. *As it is necessary to force the steam through the pipes, this expansion must be resisted until sufficient force is accumulated to accomplish this result. Now, this mechanical work is performed at the expense of temperature. If a building is warmed by steam, three-fifths of the force generated by the burning fuel is consumed in the form of mechanical motion.* The temperature of the steam in the boiler may be 400° or 500° Fahrenheit, but the pipes never indicate a temperature above 212° Fahrenheit. I have never found it above 190° Fahrenheit. On the other hand, air may be heated to 600° Fahrenheit, with but slight expansion, so that nearly all the force generated by the burning fuel appears as temperature, while scarcely a particle appears as mechanical motion. Here we see why Ericsson failed in his attempt to use heated air instead of steam as a motive power. Heat being applied to the air appears as temperature, but being applied to water appears as expansion, or mechanical motion.

Mr. Smead : You will notice that Sewall says that heat may "manifest itself in two ways," etc. Now you will remember that we are mainly interested in the question of *warming*. We have no machinery to run, we simply wish to get as much *warmth* as possible from the fuel consumed.

Dr. ——— : To warm a room how could the fuel be burned to get the most degrees of heat in the room ?

Mr. Smead : By piling it upon the floor and burning it, assuming that we get perfect combustion. The Cave-dwellers, Esquimaux and North American Indians have appreciated the economy of this method. I claim almost an equal economy for the system of heating that I shall describe, and a plan, too, that, unlike the steam-heating apparatus with its miles of pipes, does not ruin the basement for other uses than for heating apparatus.

Locate an air-warmer in the basement ; surround it with a wall of non-conducting material (brick answers very well) ; have the space between heating apparatus and wall in free communication with outer air below, and construct free conduits into the rooms above to be warmed. Now, as soon as the fire is started (the products of combustion being disposed of by a special flue) the air in immediate contact with the heated iron of the furnace is displaced upwards by the cooler and heavier air from without, and is conveyed by the warm-air conduits into the rooms above. Thus, you see, the warming of the rooms begins with the first consumption of the fuel, and there is no warming of a volume of water (or more often thawing out a volume of ice) up to 212° before heat is obtained in the rooms above.

Dr. ——— : I notice that you admit that successful warming can only be secured by means of proper ventilation.

Mr. Smead: Three things more are necessary, doctor, namely, properly constructed warming apparatus, successful engineering as to its location, and decent care after apparatus is properly set.

Dr. ——— : Your plan seems correct, and I do not see any necessity for the use of steam to convey the heat generated to the room to be warmed, as the force necessary to make it go there must be at the expense of fuel.

Mr. Smead: So it is; "three-fifths of the force generated by burning fuel is lost," while with the natural system (ventilation by flues), very little is lost, as they, if properly constructed, do their duty "without charge."

Dr. ——— : But why is steam so often used?

Mr. Smead: It is not used nearly as much as it used to be, and but little in schools, churches, etc.

Dr. ——— : In what class of buildings would you recommend its use?

Mr. Smead: There are several kinds; for instance, a business block containing a large number of offices, elevators, with large, open corridors, etc., but *never* where the question of ventilation or cost is an important factor to be considered. In a factory where the exhaust steam from engine can be used and heat thus secured costs nothing, and heating by *direct radiation* is the only plan that can be used (owing to construction of the building), then I would use steam; or in any other building where power is required and the only thing to consider is the question of *temperature*. But simply to secure uniformity of *temperature* and *ventilation* the use of steam is entirely unnecessary, as better results can be secured at much less cost and entirely without danger.

Dr. ——— : Is there really so much danger?

Mr. Smead: There is so much that if either of my two children were attending school in many of the buildings in which I have been, I should be in constant fear for their lives. The talk about "low pressure" and "twelve-year-old boys" acting as engineers for steam-heating apparatus is all nonsense. Of course "low pressure" is much safer than "high pressure."

Dr. ——— : Manufacturers of steam-heating apparatus talk a great deal about "indirect heating."

Mr. Smead: Yes, so they do, since necessity for ventilation became so apparent and we succeeded with a system of indirect heating. Twenty-five years ago no one heard them proclaim its merits, and they never would have done so but for the remarkable success of our work.

Dr. ——— : Previous to that date steam heating was by direct radiation?

Mr. Smead: Yes, by coils placed either around the sides of the room or bunched together in a radiator.

Dr. ——— : But these would only warm the air in the room; a stove will do that.

Mr. Smead: A stove would do *better* than the steam coil, as the air used to support combustion of fuel in the stove is of necessity drawn from the room, and to that extent ventilates it. Sewall says:

> Few persons seem to understand just how the air in a room is warmed. It is generally thought that the air in immediate contact with the burning fuel or heated stove is warmed, and that this warms another, and so on until all the air in the room is warmed. Not so at all. The air next to the burning fuel, in the case of the open fire, is warmed, and for the most part goes up the chimney. A small part, however, arises, and the cold air takes its place. The heated air that rose slowly cools, and is displaced by the warmer and rarer air just escaped from immediate contact with the fire, and after a time falls and is again warmed. So that we see only a small part of the air of the room is warmed, while whole oceans are heated and escape from the chimney. If a stove be used for heating, only a small part of the air comes in contact with the burning fuel—in fact, just enough to oxidize the fuel, while the air about is heated and rarified, and then pressed up by the cooler and heavier air, which is in turn heated and forced up, and thus we have a current of air established, moving toward the stove, then up to and along the ceiling, then down to be warmed again. But as this current takes place in a closed room (and the tighter the better, we think), of course it is the same air moving in a circle, to which we are constantly imparting the carbonic acid of the breath, which is warmed and circulated and breathed again, and if our rooms were absolutely air-tight in a short time the air would be so saturated with carbonic acid as to produce death.

The "hot-air furnace" system had failed, people must be *warm*, the steamfitter could (as I have said before) put in a large boiler, introduce pipes in the rooms, and get the building *hot*.

This was the condition of affairs when we commenced to work for proper construction of flues for supply and exhaust. The result of our success with the system of ventilation and progress in inventing an "air-warmer" was to frighten the steam-heating fraternity, and so they commenced to advertise that they could do with their apparatus anything we could do with ours; some of them would guarantee to *cure corns* with their apparatus if customers should request it.

Dr. ——— : Didn't you have patents to protect yourselves?

Mr. Smead : Yes; but for selling purposes what does the imitator care about that? They have always been very careful to put in enough pipe for direct radiation to heat the rooms in cold weather; the indirect is generally a blind.

Dr. ——— : Why?

Mr. Smead : Because the temperature of the steam in the pipes cannot be over 212 degrees (generally is about 190 degrees); and a coil as ordinarily placed in a cold-air conduit, with air at say 10 degrees below zero, cannot stand the cold, steam is condensed and pipes are frozen.

Dr. ——— : But even if such were not the case and pipes could warm the air, would not the same importance attach to proper construction of flues?

Mr. Smead : Certainly it would, and there is where they fail again. Our system of construction varies as buildings vary; our skill as engineers is the result of many experiments and past experience. They would introduce in a building something they had seen built under our supervision in some other building differing in many ways from theirs; failure followed in both heating and ventilation, and in some instances I have known them to *blame us!* As a member of the Board of Managers of the Ohio Penitentiary for several years, I have gained considerable information concerning crime, and have some acquaintance with criminals; *but I have more sympathy for the highway robber than for the thief who would steal the ideas of a mechanic or pass as his own the ideas and designs of others. I have read circulars issued by would-be competitors containing whole pages cut from our publications. I have known them to copy our cuts, errors and all! One came near getting into the penitentiary for violating the copyright law.*

Dr. ——— : I hear them talk about "direct indirect"; tell me something about that.

Mr. Smead : It is too much of a humbug to waste much time on. The indirect failed for reasons I have given, and as the main dependence had always been on the direct pipes (pipes in the rooms), they all went to that with a rush and commenced to yell in favor of "direct indirect." You ask what it is. Simply this: a few holes bored through the walls back of the pipes, through which holes fresh air is supposed to come from outside and pass into the room over the pipes. I recently examined a school building said (by the architect and steamfitter) to be "well ventilated." It contained the "direct indirect" system. The fresh air for sixty pupils was supplied through *eleven holes one inch in diameter.*

Dr. ——— : How large should the opening have been?

Mr. Smead : Not less than 16 by 30 inches.

Dr. ——— : What means had been supplied for exit of air from the room?

Mr. Smead : A register at the ceiling.

Dr. ——— : But that would let the warmest and best air out!

Mr. Smead : No, it wouldn't, for the teacher had closed it!

Dr. ——— : Was the room warm?

Mr. Smead : Yes, hot as an oven, and air so foul that the president of the board (who had voted for the apparatus) and I were glad to go outside into the rain.

Dr. ——— : But what about the pupils, who were obliged to remain?

Mr. Smead : Oh! they must stand it. They go home tired, and their parents say they are "overworked and need rest." Sometimes they get sick and die, and the preacher talks about the "dispensation of Providence." So it was; but Providence made that law of hygiene long before school boards were organized or air-tight rooms, heated by direct radiation, were constructed.

Dr. ——— : But some claim that "air heated by steam coil is more moist."

Mr. Smead : Another false claim. But do you, a doctor, intimate that "moist air" is beneficial?

Dr. ——— : I know it is not, and I did not say it was. I only mentioned the claim made by the steamfitters.

Mr. Smead : They claim anything to secure a contract. I have known them to claim that a "warm floor is unhealthy," and argue against a warm floor in a schoolroom because "it dried the leather in shoes of pupils and makes them brittle."

Dr. ——— : Medical books and doctors say that we should keep the feet warm and the head cool.

Mr. Smead : So does common sense ; but I cannot always keep my head cool when I hear some of the talk of the manufacturers of steam-heating apparatus. But they are not all so foolish ; here is a letter I recently received from one. I have never met the writer, but am told that he is very competent in his business.

> Your system is bound to go ahead ; you cannot keep it from the people when they find it out, and all that is necessary for you to do is to go and "proclaim the gospel to all the nations of the earth." This is an age of progress, and I, for one, am not satisfied to float along on the old plank of "good enough." I say that steam heating is *not* "good enough" ; and, also, that your air-warmer and system of ventilation is the best, as far as it goes ; but you do not let it go far enough. I wish you would establish an office in our city, and wake our sleepy firms up to the fact that the people want something better than they are receiving for their money.
>
> I should like very much to meet you in person. I hope you will not accuse me of jumping at conclusions. I have *never* been satisfied with steam heating. I have been studying the Smead system more than a year. I cannot see why the frank, honest manner in which you, in your recent publication, acknowledge the former mistakes made by yourself and your predecessors, and the sound reasoning by which you arrive at your present conclusions, should not be convincing even to the most skeptical. *I blushingly confess myself a concert.*
>
> Yours truly, ——— ———.
>
> ——— December 21, 1886.

Dr. ——— : But why is steam used at all in public school buildings ? They only require rooms warmed a few hours each day.

Mr. Smead : It is not used very much now ; not introduced into many new buildings. Of course, when plant is already in use, people as a rule do not like to incur the expense of a change, although I have removed very expensive plants from more than one hundred buildings and introduced my own — for instance, three large public school buildings, including the High School building, in Toledo. The plant removed from the High School here cost over $20,000, original cost and *repairs.* I also took out the steam apparatus from Defiance County Court House. Here is a clipping from a Defiance paper upon the subject :

THE TRUTH!!

A PLAIN STATEMENT OF FACTS REGARDING THE NEW SYSTEM OF HEATING IN OUR COUNTY BUILDINGS, WHICH PROVES THE ARTICLE IN LAST WEEK'S DEFIANCE "EXPRESS" TO BE UTTERLY AND MALICIOUSLY FALSE.

Ever since the County Commissioners began the removal of the old steam-heating apparatus from the court house and jail, and the construction of the Smead system, a certain set in the county, who have always been noted for their unfairness in everything from which political capital could be made, and their total disregard of the truth concerning any such matters, have been circulating reports throughout the county calculated to mislead those who may not know the facts concerning the causes which led the County Commissioners to make the change above referred to. For this reason we have taken considerable pains to examine the whole subject, with a view to giving our readers a full, true and just statement of the subject.

Ever since the steam-heating apparatus was placed in the court house and jail it has been a source of trouble to the Board of Commissioners on account of the very poor results obtained from it, and more particularly on account of the cost of operating it and *keeping it in repair.* Several changes were made by the different Boards of Commissioners with a view to obtaining better results, and a saving in the amount of fuel used ; but no benefit of any consequence was obtained by such changes. For several years the idea of removing the steam-heating apparatus, and the adoption of some other system in its place, has been under consideration by the commissioners ; and yet, on account of the expense growing out of such change, and the possibility of any system of heating which might be adopted proving to be a failure, the matter has been postponed from year to year until during the last summer. We have not been able to examine into the cost of maintaining the old steam apparatus for any number of years, but an examination of the accounts in the auditor's office shows that the cost of the fuel for the year ending September 1, 1888, was $1,533.56. If this were all, we still believe the commissioners would be justified in making the change which they have made. But this is not all by any means. During the year 1887 it cost for repairs in and about the old steam-heating apparatus, $613.26. We are advised by those who have the means of knowing that neither the cost of the fuel nor the cost of the repairs given above are much if any above the average of each year. But this was not all that entered into the consideration of the question by the County Commissioners. Nearly all of the steam pipes in and about the basement in the court house had become rusty and defective, so that it was but a question of time when an entire new set of pipes and fixtures, as well as new pumps and boiler, would be required in order to use the apparatus at all. This would cost a much larger sum than the cost of putting in the system which is now in operation. An examination made by the County Commissioners of other court houses and other buildings where the Smead heating apparatus is in use convinced the commissioners that the cost of maintaining the old steam apparatus was more than double what it would be if the Smead system were used in its stead.

In the Defiance Union School building the Smead heating apparatus has been used for about six years. The average cost of the fuel for this building per year has been about $575, while the cost of repairs has been less than $10 per year. When it is considered that a greater extent of space is heated in the Union School building than in the court house and jail combined, one can readily see that the cost of maintaining the old heating apparatus in the court house and jail was much greater than it should be.

Before any change was decided upon the matter was carefully discussed, and the opinion of those who had the means of knowing with what success the Smead system could be operated was obtained. These opinions were obtained from democrats and republicans alike, and, without a single exception, every person who was consulted upon the subject, who had the means of knowing the results to be obtained by the Smead heating system, was heartily in favor of the adoption of that system by the commissioners for the heating of the court house and jail. The commissioners, therefore, decided to remove the old steam apparatus, and to adopt the Smead system.

Those who have not the means of knowing the cost of this change have been told by the unscrupulous parties referred to in the beginning of this article that an enormous amount of money was expended in making this change; and to show that these reports have been circulated wantonly and maliciously, we need only say that in some parts of the county the expense had been reported to be $15,000, while in other parts of the county it has been reported to be $28,000. Neither of these amounts are correct. The fact is, the entire cost growing out of the change, including the cost of the furnaces, the expense of removing the old apparatus from the court house and jail, and in fact the entire cost and expense on account of the change, is less than $4,500. If the same result can be obtained, and there is no reason why it cannot be, which is obtained by the use of this system in the Union School building in this city, and in fact wherever this system has been adopted, the change *will be a saving in the county every year of from* $1,000 *to* $1,500. Nor is this all; so far as the new heating apparatus has been tested, it has given the greatest satisfaction. The ventilation in all of the offices in the court house, as well as in the court room, is perfect.

The county officers in the court house, the attorneys who are in attendance at court, as well as all other persons about the court house who have had an opportunity to observe the results of the new heating system, speak in the highest terms of it.

We were told by the clerk of the court that, during this changeable weather, with a very little care the court room could be kept at a temperature which did not vary one degree in a whole day. What is true concerning the success of the Smead heating apparatus is true also of the Smead dry-closet system, which has been placed in the basement of the court house. The County Commissioners invite the most careful examination into this system, and especially request all those who may not be satisfied concerning the matter to call and examine and learn for themselves.

We have said this much upon this subject because we believe the taxpayers of this county have a right to know the *truth* concerning this matter.

Mr. Smead: Do you want to continue the steam-heating subject any longer?

Dr. ———: One more observation. It strikes me that the steamfitters are not in favor of much advance in this field of sanitary science.

Mr. Smead: I don't care whether they are or not. I don't think they are, as they are always ready to pool their issues to beat us, annoy us by circulating all sorts of lies, print columns of trash in the newspapers, and occasionally squander their money by an injunction after the award of a contract; but the courts have never yet decided against us, and I don't think they ever will. I have no respect for a person who will whine after being beaten in a contest where merit is the question. The next time you come in we will take up another subject, one that has caused the plumbers much anguish of heart and many tears, and caused them to join hands with the steamfitters in their crusade against us. I refer to my system of *Dry Closets*.

* * * * * * * *

Dr. ——— : I am here early this evening, Mr. Smead, and, if necessary, am going to stay late; for I have heard a great deal about "Smead's System of Dry Closets" during the past two or three years, and am anxious to learn of its merits and demerits. I am serious upon this subject, for, next to the importance of proper ventilation, I know no sanitary question of greater importance, and especially since we have learned so much about the danger from sewer gas.

Mr. Smead : There are now over one thousand of my dry closets in use. The first one ever built was erected in the basement of what is known as the South Street School building, Toledo, and first used during the winter of 1884 and 1885. More than one hundred cities sent committees here during the years of 1885 and 1886. One committee came over two thousand miles, a half-dozen came one thousand miles, and more than a dozen came five hundred miles; and since the date named (1885), as before stated, more than one thousand closets have been erected.

Dr. ——— : How did this happen to come about so suddenly?

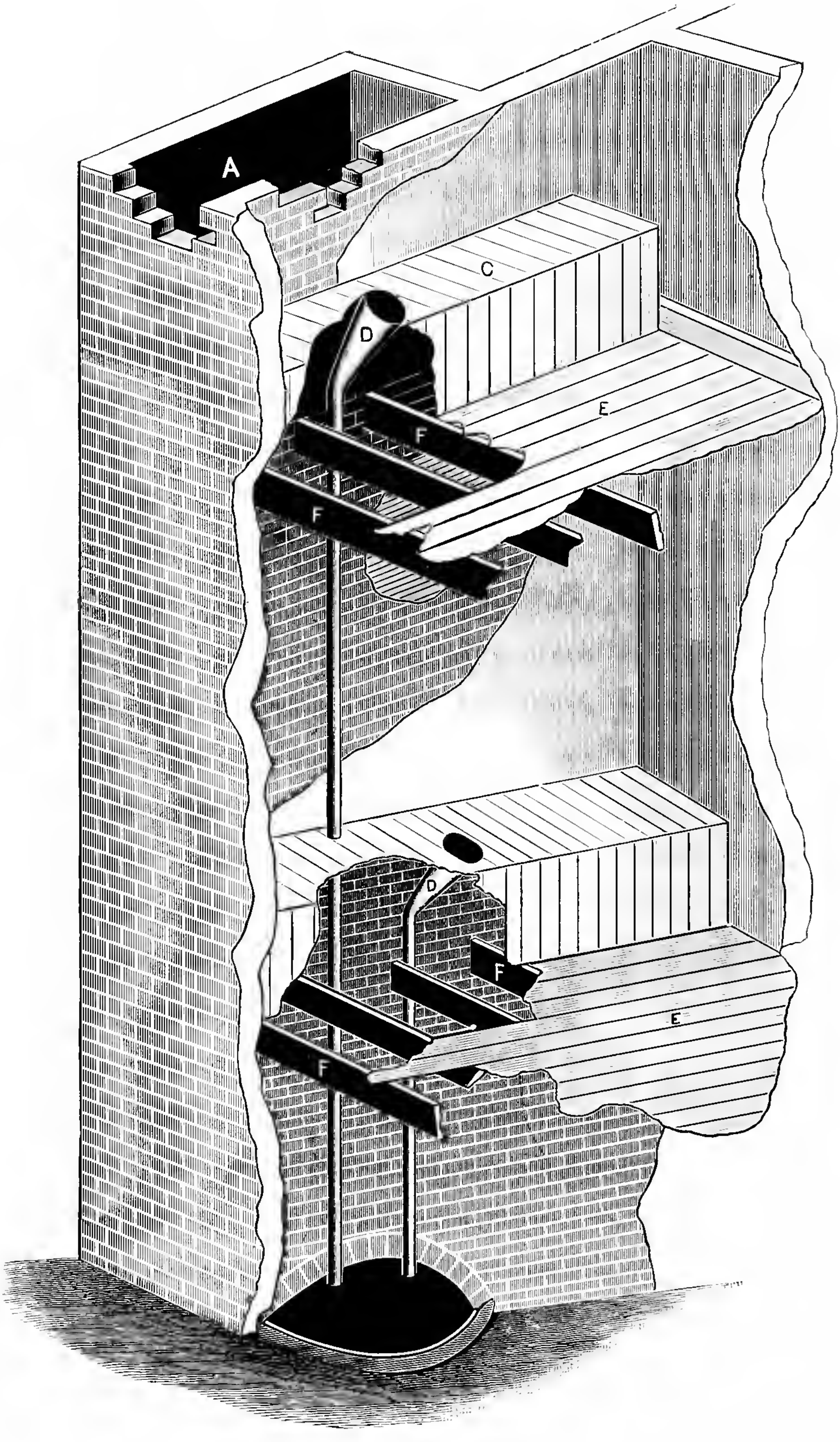
Mr. Smead : It didn't come suddenly, so far as my wishes were concerned, nor do I claim to be the father of the *idea*. The situation in which I was placed made it impossible to carry out the plan I designed, and which I claimed would make successful a theory suggested, but never applied, by Mr. Ruttan. My employers had attempted to follow his plan, and the failure was so complete and their disgust so great that the subject was almost a forbidden one in the western offices. My associates laughed at the idea, and I could get no building committee to let me try it, and there the matter rested, until by chance, and by some deception on my part (I didn't tell a lie, but I didn't tell the "whole truth"), the Toledo Board were almost forced to adopt it. They had commenced the erection of a school building without knowing they were beyond the city sewer limit, and the work was well advanced. This extract from the annual report of the board will tell the story better than I can :

> Most of the school buildings in our city are three stories high, thereby causing a great deal of unnecessary climbing of stairs. The board some time ago concluded that it was best hereafter to erect buildings only two stories high. The South street building is the first complete building of this kind ordered erected. It is composed of eight rooms, four on each floor. The basement is large and roomy. In connection with this building another important departure was made. The board have long been of the opinion that it is unwise to force little children in inclement weather to pass through rain and cold to yard water-closets, and were also sensible to the unsatisfactory arrangements of water-closets in the buildings. In this dilemma a consultation was invited with Mr. Isaac D. Smead, heating and ventilating engineer. Upon consultation and examination of the plans presented it was found that it would cost much less to construct closets upon this plan than upon any other, and the work was ordered done.
>
> At the time of the writing of this report, and after the occupancy of the building, it is found that the basement is entirely free from all malodors, and an examination of the closets will convince anyone that the system is a complete success.

Dr. ——— : You say the plan was *suggested* by Mr. Ruttan?

Mr. Smead : Yes; here is his book and what he said :

> If the City Council of London, some hundreds of years ago, could have foreseen the lamentable picture presented in a late report by the Board of Commissioners to report upon the sanitary condition of the city, appointed in consequence of the effluvia arising from the filthy condition of the Thames, I cannot believe that it would ever have permitted the draining of water-closets into the sewers. This great city, with its millions of human beings, is in a most perilous and deplorable condition, and if its present system of drainage and sewerage be continued, I cannot imagine in what way it can escape depopulation by pestilence.
>
> There should be sewers, and there should be drains, no doubt, in every large city, but only to carry off the *water*, not the sordes or the excrementitious matter from the human body; this should all be *carried* away. This idea will at first view be pronounced a most herculean, as well as an intolerably offensive, work. Not so; *the residue of twelve ounces of excrement will weigh, when dry, only about two ounces.*
>
> Let us suppose, then, a building and the water-closet to be so arranged that all deposits fall *directly at base of ventilating stack.* Then suppose a volume of air flowing closely over the brick or earth basin, made at the bottom to receive the sordes, and up the shaft at the rate of five feet per second all the year round; such will be the power of evaporation that one man will carry upon his back at one load the whole of the deposits for years. This surely is no great trouble or expense—nothing to be compared to the expense which is now incurred in keeping the ordinary cesspools and drains in order. In order, however, to make this



THE DRY CLOSET AS SUGGESTED BY HENRY RUTTAN.

residuum more conveniently available to be entirely consumed upon the premises where there is even a very small patch for a garden attached, lime, ashes or plaster of paris should be thrown down the pipes of the closet, in the proportion of about a gallon per week. This will not only render the mass hard and easily cut up for removal, but the ashes and plaster of paris will *fix* and retain a great portion of the ammonia, so valuable to flowers and, indeed, plants of any kind.

But let us look at the actual state of things as at present. Every water-closet and cesspool is drained into the sewers; the mouths of these sewers are in general run down to the edge of some body of water, which does not always cover the *whole* mouth, as it should do in order to exclude the air, and especially does it not exclude the air at low water where there is a tide. The consequence is that every house whose drain is not in perfect order becomes a foul-air shaft for the sewer, and the heat and chimneys accelerate the flow of air from the drains upward and into the building, and especially so when the wind blows into the mouth of the sewer, which it frequently does. The inmates, therefore, of these dwellings have not only to endure the malaria generated within their own dwellings, but have also the *advantage* of that of their neighbors. I have stood at the mouths of many sewers, and instead of experiencing any offensive odor as I had expected, I frequently found a strong draft *into* the sewer. Thus, in these cases, these sewers carried down the insoluble matter, which, in a sanitary point of view, could do little harm, while the noxious gases were carried up into the houses.

These sewers, instead of thus becoming the greatest nuisances we have, might, in addition to being the conduits for the waste water, be turned to good account in the ventilation of a whole city. Erect foul-air shafts—say about four for every mile—at convenient places adjacent to the sewers, and connected with them by underground ducts, and the exhaustion thus brought to bear upon the sewers, and the sewers upon the drains, would go far to improve the sanitary condition of our cities. If the civic authorities would be at half the expense of the erection of the many furnace-shafts scattered over our largest and most populous places, upon condition of the proprietors allowing a connection with the sewer in the way stated, a very cheap and effectual exhaustion might be had. In general, however, a single shaft erected at or near the mouth of a sewer would, if properly built, be found sufficient.

Here is a cut from his publication with which he represented the method he recommended (see cut page 62). Please notice his language. He says "so arranged that all deposits fall *directly at the base of the stack*," and the cut so represents it. My employers built several sets of these closets, and so far as *ventilation* was concerned there was no *odor* in the closet; but Mr. Ruttan's statement that the deposit would become dried was absolutely false, and, as you see, must of necessity have been so, as so *much* water had to be evaporated and so *little* air would touch it. The collection remained at the base of the stack in about the same condition that it arrived there. Some fifteen or twenty were erected. I built some myself, and have since learned that they were all abandoned.

Dr. ——— : But the cut you show me does not represent the Smead closets at all.

Mr. Smead : No, it does not. I call your attention to it and to Mr. Ruttan's remark because I want you to know all about the dry closet system that *failed*, as well as the one that has *succeeded*.

Dr. ——— : Mr. Ruttan, it seems, called attention to the necessity and suggested a plan that *failed*, while you *succeeded*.

Mr. Smead : Yes, far beyond my expectations as far as approvement by the public is concerned. I always insisted that if a long vault were constructed in the basement, over which were placed the seats, and one end of the vault connected with the ventilating chimney, the air passing through the vault would dry the deposits, provided the engineering was properly done. Here is a drawing representing my first experiment in the South Street School building. (See cuts pages 64, 65, 66, 67, 69 and 70.)

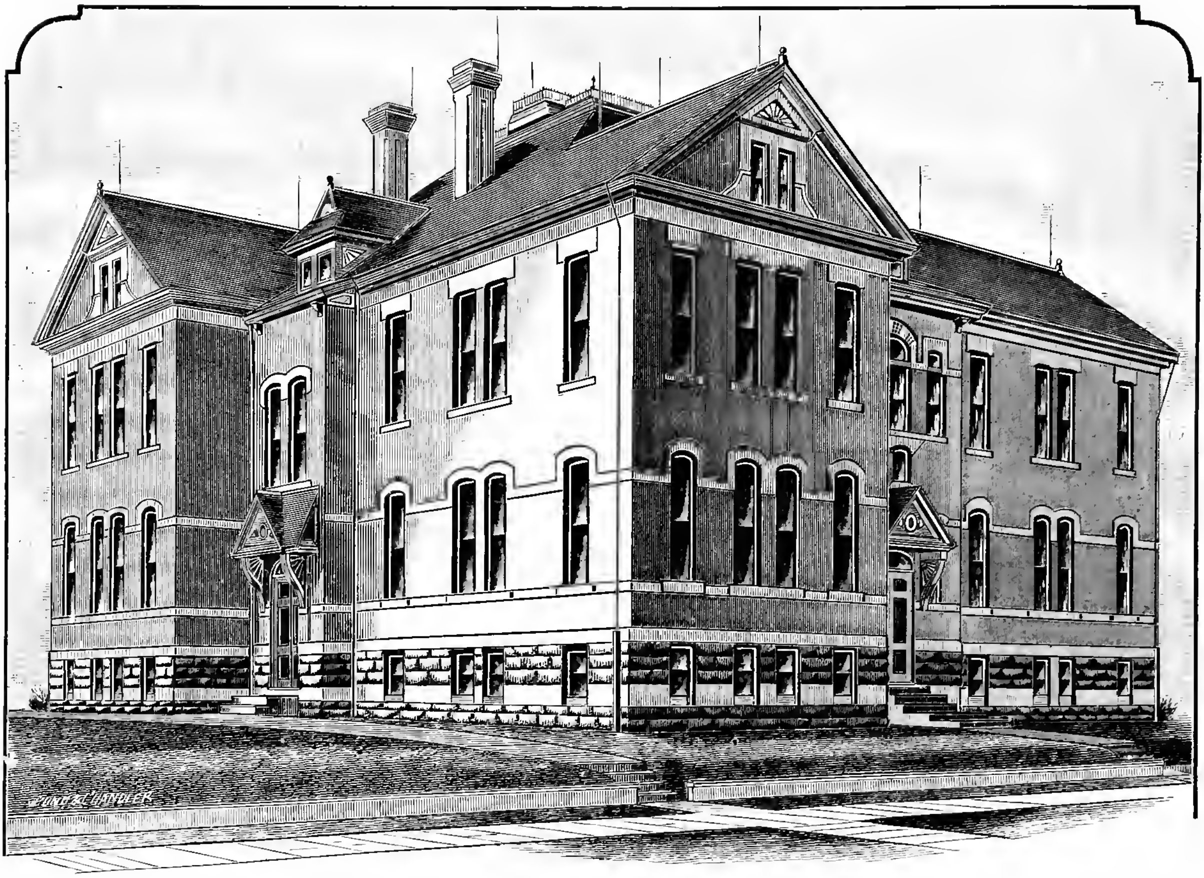
By examination of the cut showing the suggestion made by Ruttan you will notice that all deposits accumulate at one point, namely, "at the base of stack." He even provides a basin or cesspool, and I can assure you that it *was* a cesspool.

Dr. ——— : With your plan you divide the deposits and so arrange the vault that air has free access to all accumulations.

Mr. Smead : Yes, and all moisture is taken away.

Dr. ——— : What becomes of the vegetable and animal matter ?

Mr. Smead : It remains in the vault, as dry and hard as the buffalo chips on the plains. I have made other improvements since the first ones were built. I now construct the seats and

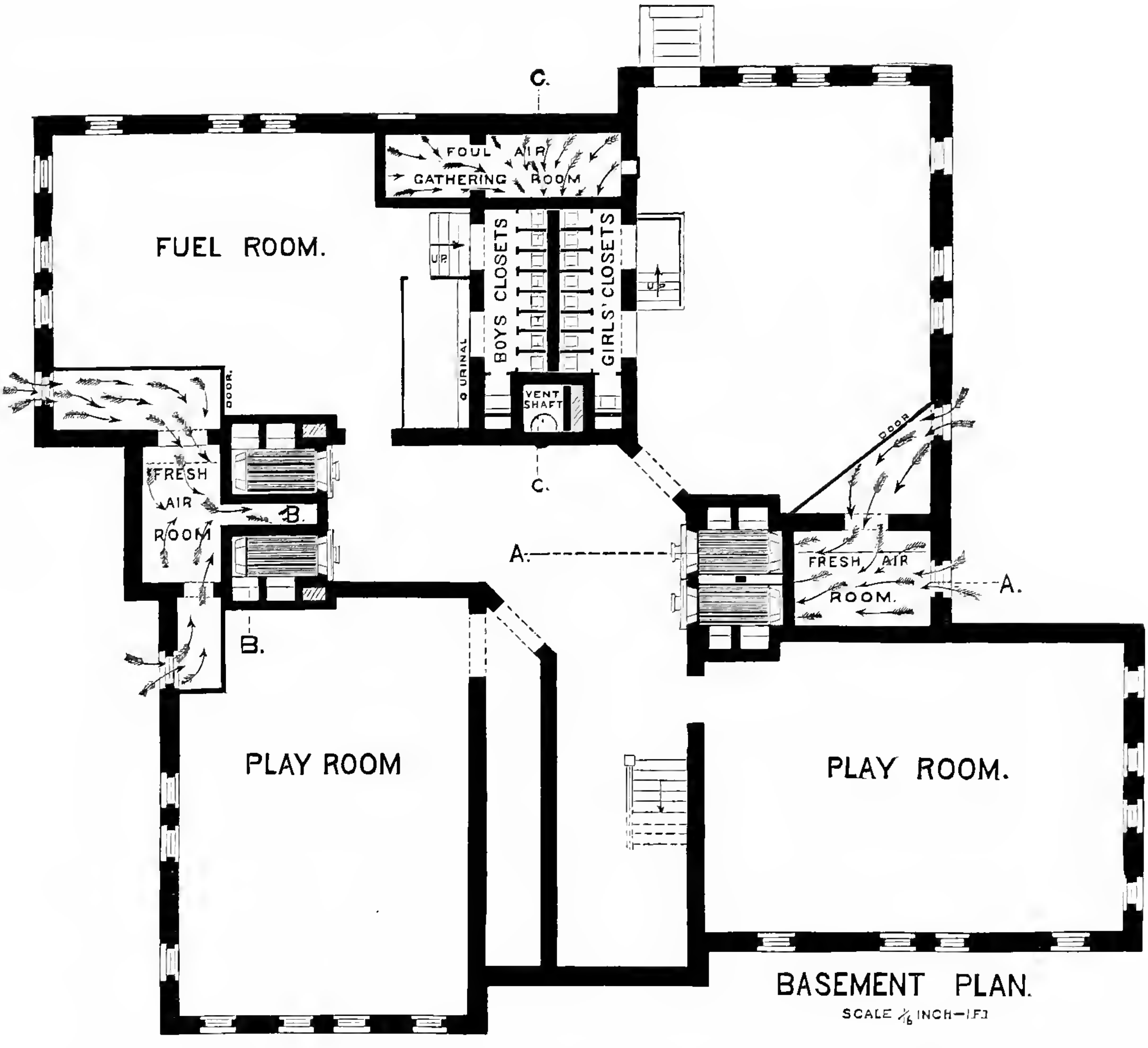


SOUTH STREET SCHOOL BUILDING, TOLEDO, OHIO, ERECTED 1884.

D. W. GIBBS & CO., TOLEDO, ARCHITECTS.

For basement plans, floor plans, sections and instructions, see pages 61, 63, 65, 66, 67, 68, 69, 70, 71 and 73.

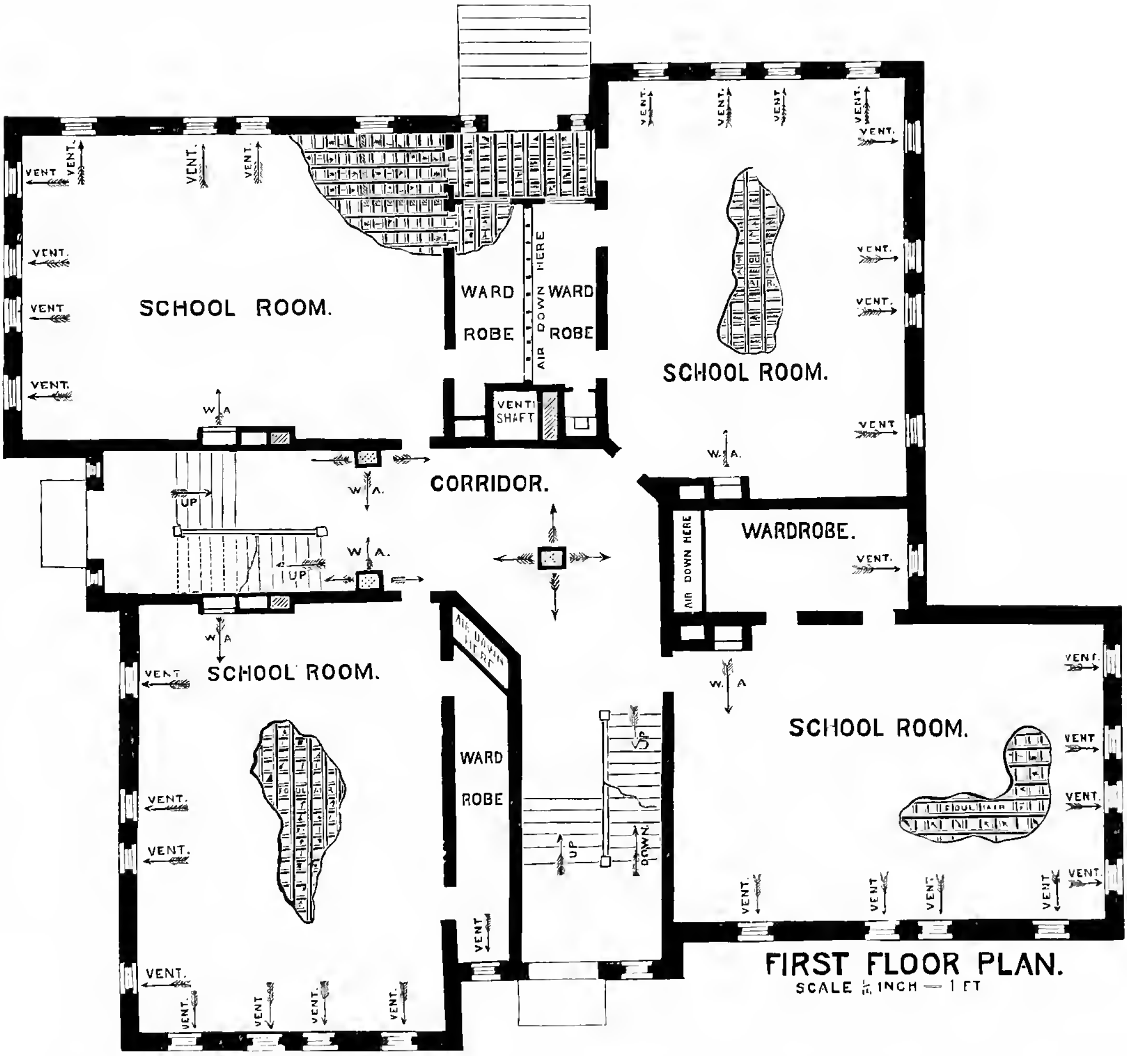
(Twenty-six school buildings in Toledo warmed and ventilated by the Smead system.)



BASEMENT PLAN SOUTH STREET SCHOOL BUILDING, TOLEDO, OHIO.

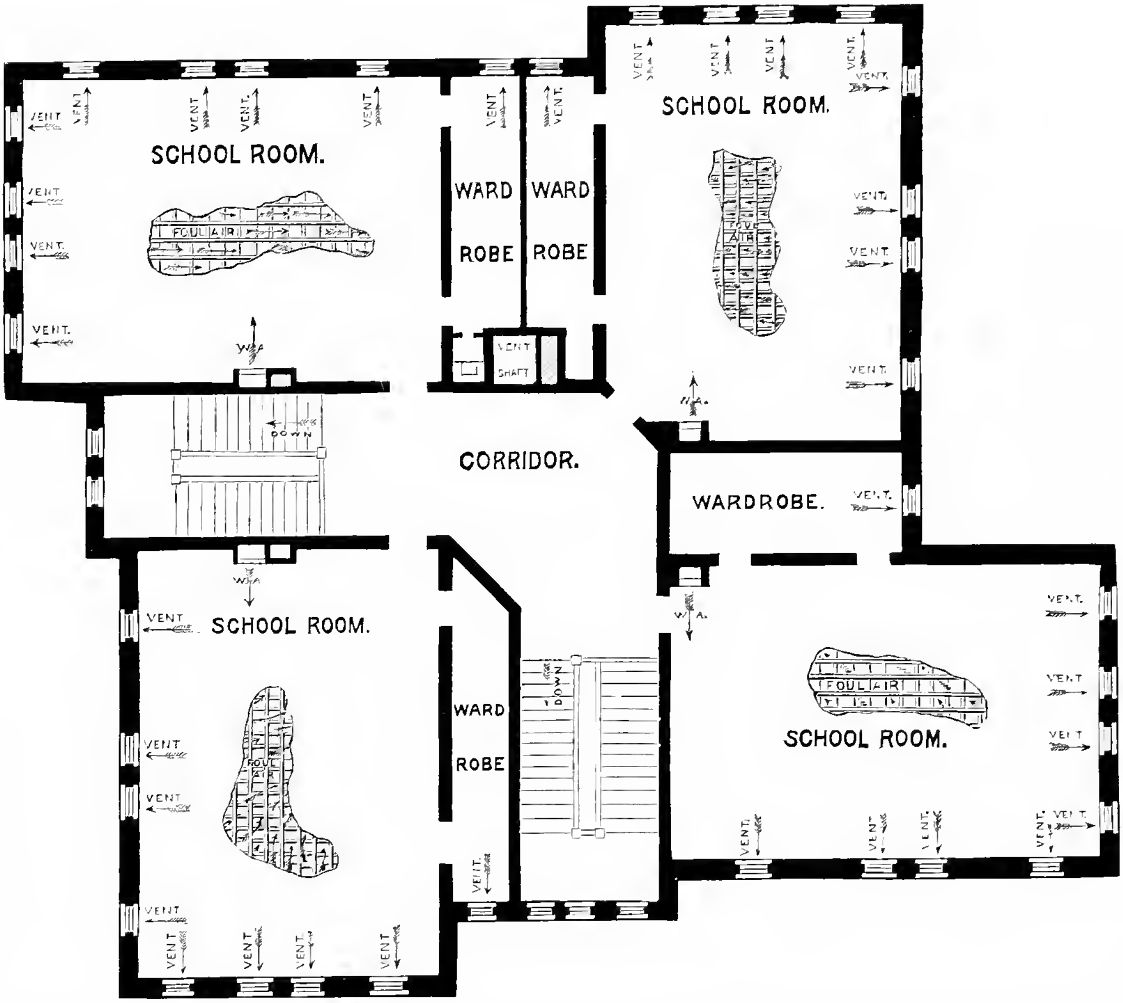
Showing Furnaces, Cold-Air Rooms, Foul-Air Rooms, Smead's System of Dry Closets, Warm-Air Flues, Ventilating and Smoke Flue.

See pages 61 and 63.

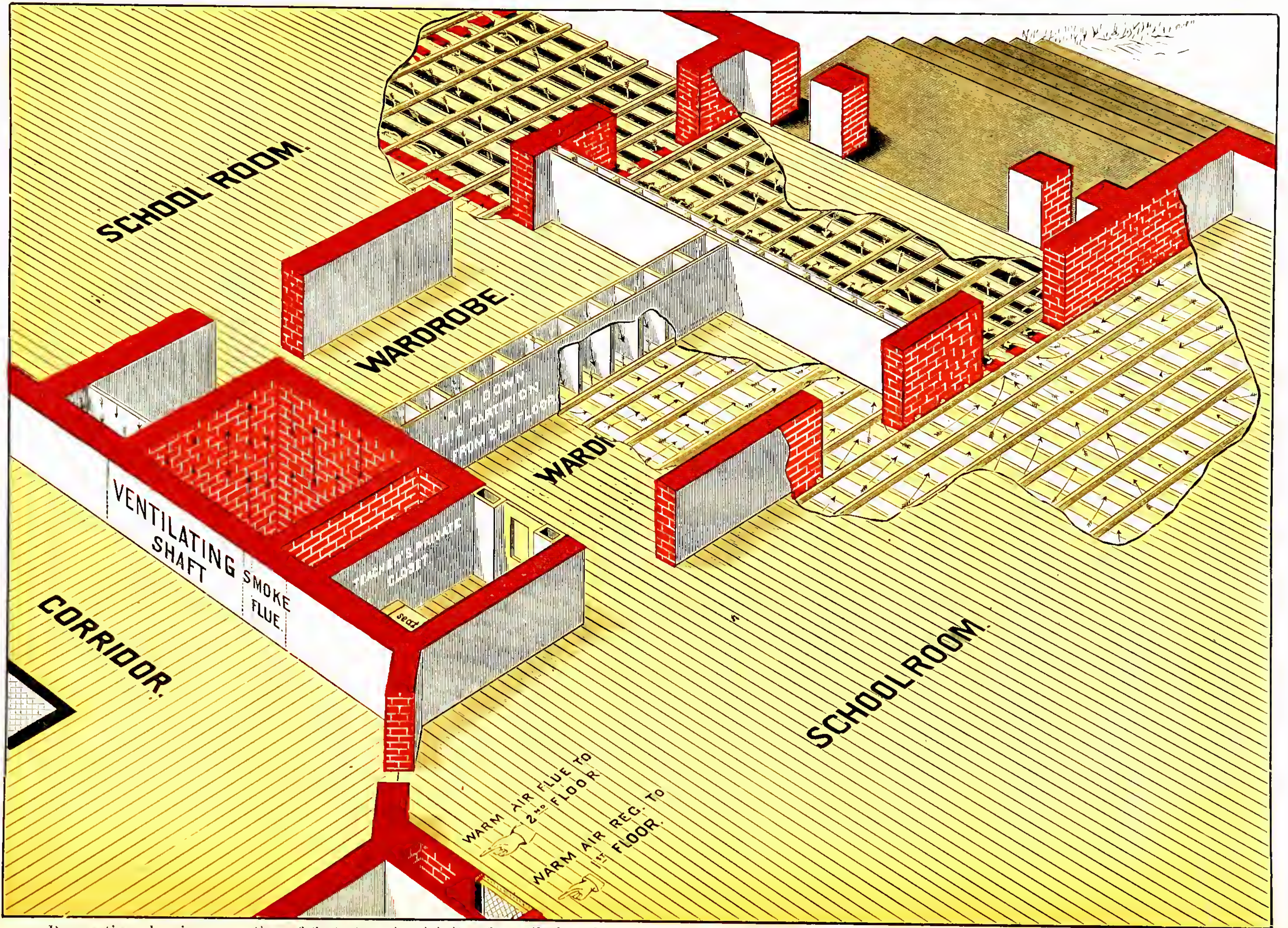


SOUTH STREET SCHOOL BUILDING, TOLEDO, OHIO.

Representing, by breaks in the floors, the passage of air under them, location of main air register in school-rooms and corridors, and also location of foul-air exits before it passes under floor.

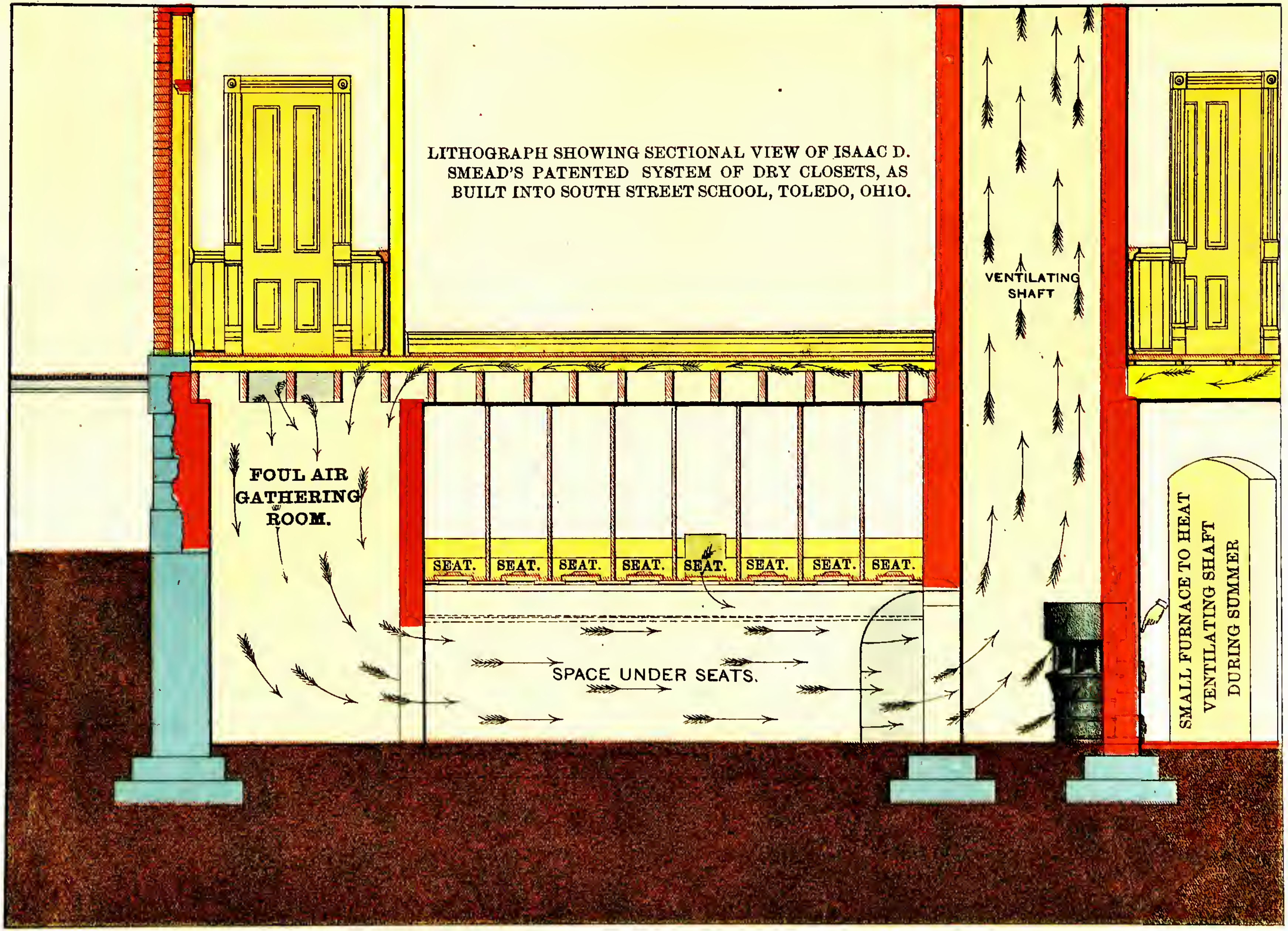


PLAN OF SECOND FLOOR SOUTH STREET SCHOOL BUILDING, TOLEDO, OHIO.

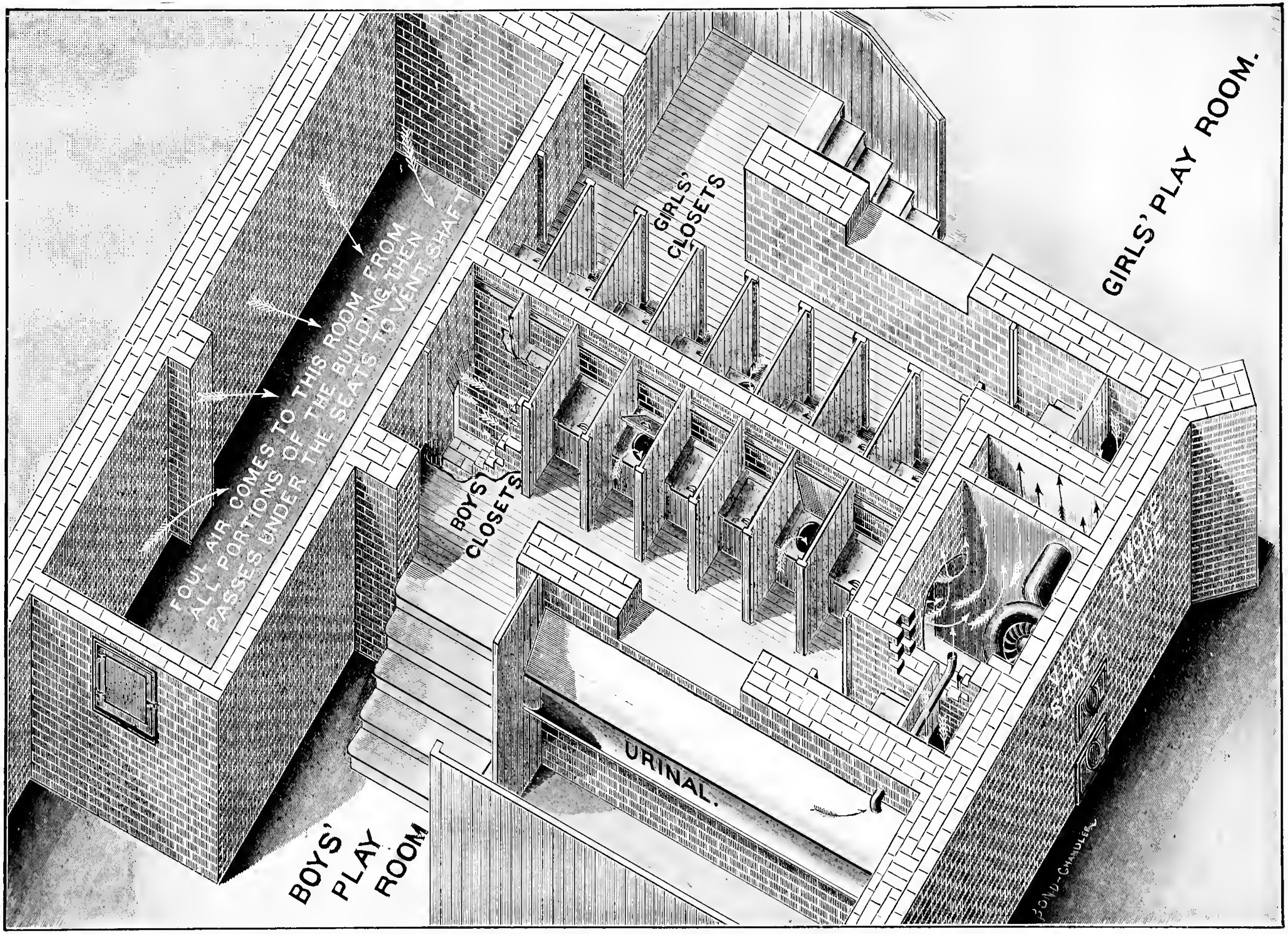


Perspective, showing a portion of first story in vicinity of ventilating shaft, South Street School Building, Toledo, Ohio. Representing ventilating shaft, smoke flue, two warm-air flues, partition down which the air comes from second story, and also passage of air under the floors of schoolrooms to foul-air room in basement, which is located directly under small corridor at rear entrance of building.

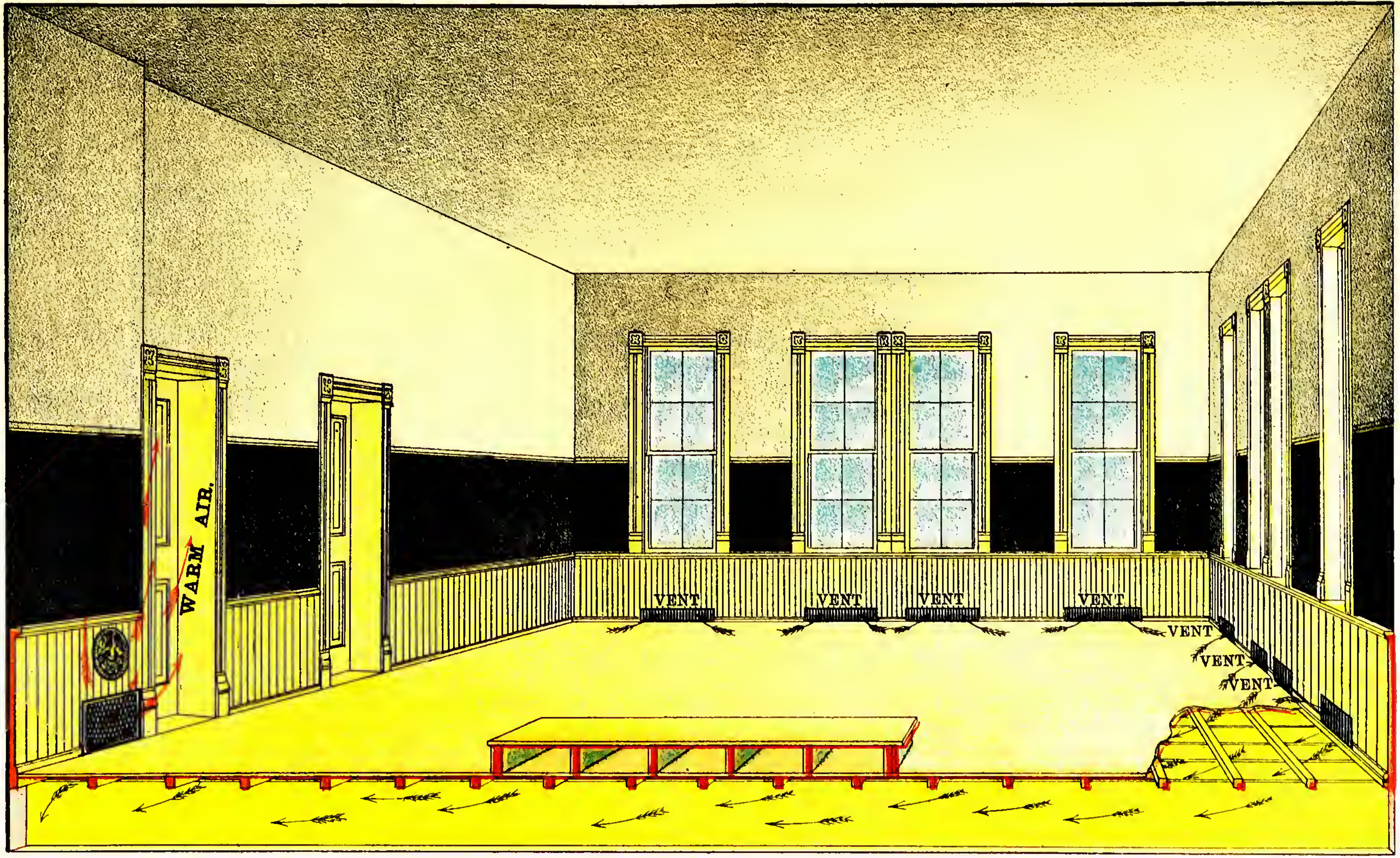
Isaac D. Smead's system of dry closets is located directly under the wardrobes. (See page 70.)


LITHOGRAPH SHOWING SECTIONAL VIEW OF ISAAC D. SMEAD'S PATENTED SYSTEM OF DRY CLOSETS, AS BUILT INTO SOUTH STREET SCHOOL, TOLEDO, OHIO.
VENTILATING SHAFT
FOUL AIR GATHERING ROOM.
SEAT.
SEAT.
SEAT.
SEAT.
SEAT.
SEAT.
SEAT.
SEAT.
SPACE UNDER SEATS.
SMALL FURNACE TO HEAT VENTILATING SHAFT DURING SUMMER

Section, Line C. C. Showing Dry Closets In South Street School Building, Toledo, O.

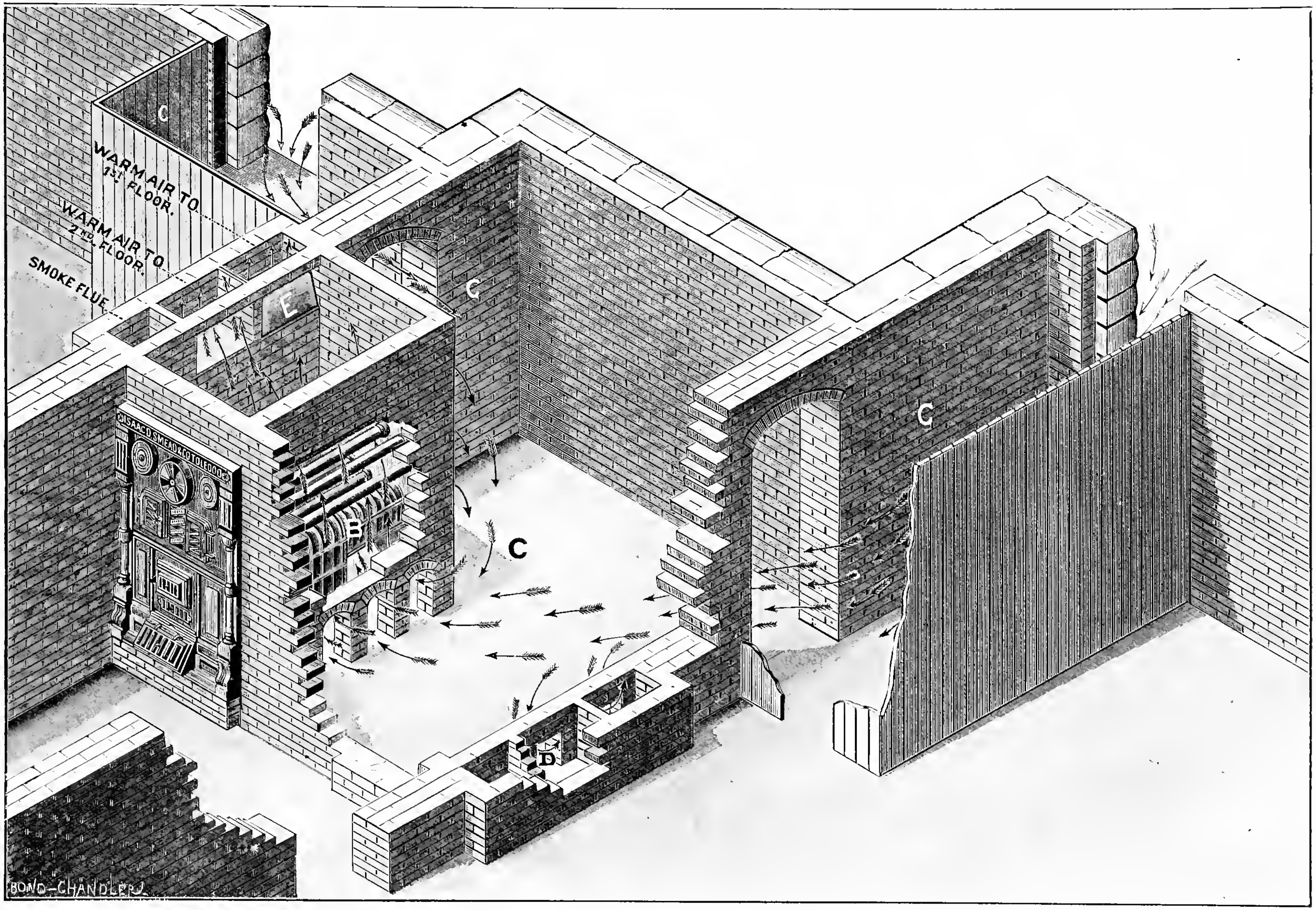

FOUL AIR COMES TO THIS ROOM FROM ALL PORTIONS OF THE BUILDING, THEN PASSES UNDER THE SEATS TO VENT SHAFT
GIRLS' CLOSETS
GIRLS' PLAY ROOM.
BOYS' CLOSETS
URINAL.
VENT SHAFT
SMOKE FLUE
BOYS' PLAY ROOM
BOND-CHANDLER

Isometric drawing representing ISAAC D. SMEAD'S SYSTEM OF DRY CLOSETS as applied to South Street School Building, Toledo, Ohio. (The drawing is not entirely satisfactory, but by careful examination of cuts on other pages, probably the reader will understand it.—I. D. S.)



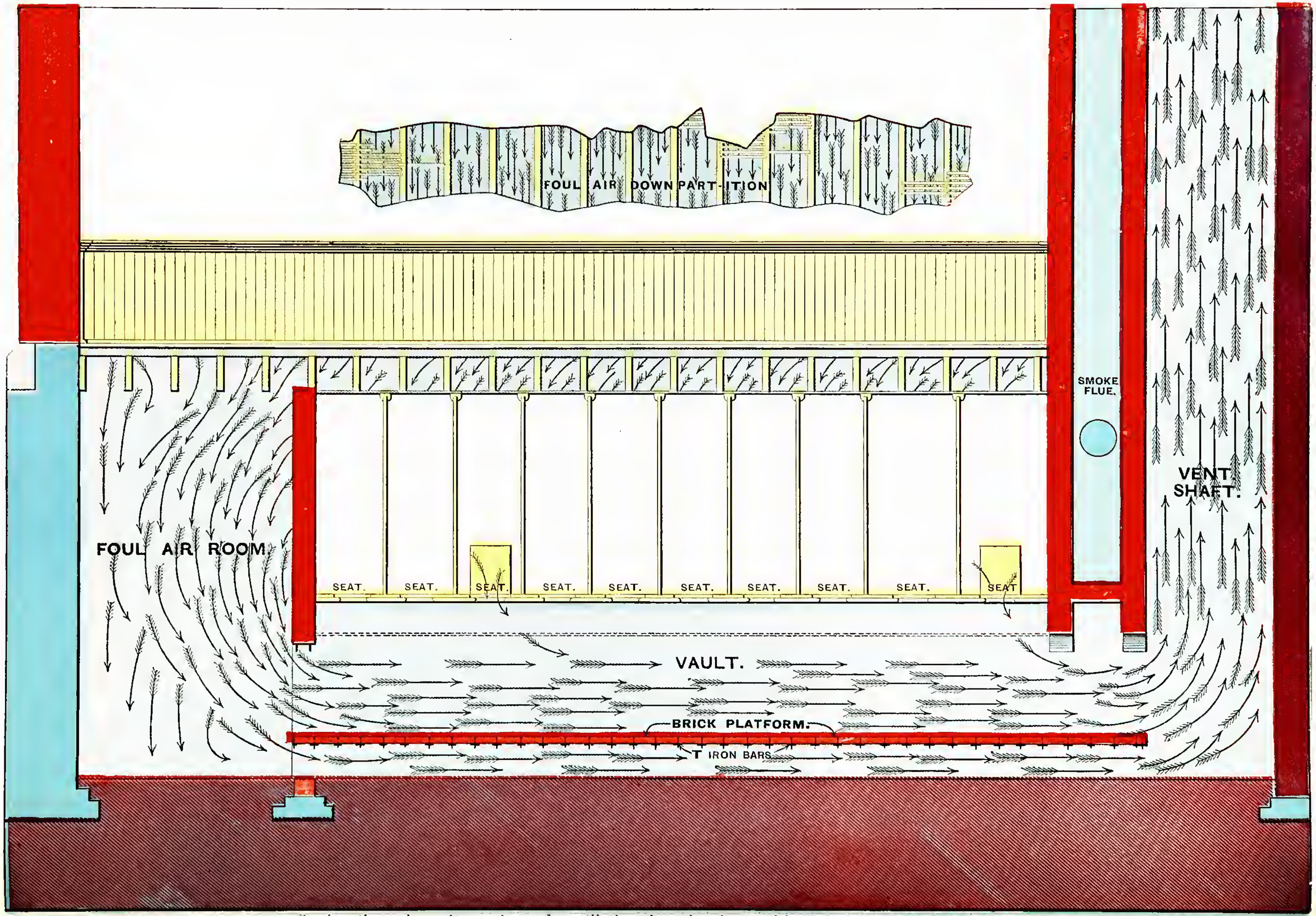
Perspective View of one School Room in South Street School Building, Toledo, O.
Showing Warm Air Register, Valve Regulator, Foul Air Exits,
Floor Joists, And Furring Strips,

NOTE.—This system of floor warming cannot dc successfully used except in connection with patents owned by us. I. D. S. & Co.



Isometric Drawing, representing one of the furnaces, cold-air room and warm-air flues in the South Street School Building, Toledo, Ohio.

B—Air-Warmer (furnace). C—Cold-Air Room. D—Entrance of cold air to Warm-Air Flue. E—Valve to control supply of warm and cold air. With valve E closed as shown, cold air will go to room through the opening at bottom of flue as shown at "D." See article on page 18 referring to Smead's system of "continuous ventilation."



Section through vault, smoke and ventilating flue, showing position of seats, brick platform, etc.

floor of iron, and, as often as may be desired, a fire started at the end of the vault most distant from the stack soon reduces all collections to ashes. Here is a recent item from our local press that may interest you:

AN INTERESTING EVENT.

A committee from Fort Gratiot, Michigan, and a number of persons from the city yesterday visited the Warren School building for the purpose of seeing the vaults of the Smead dry closets burned out.

A reporter of the *Commercial*, having heard of the approaching event, repaired to the Warren School at the appointed time to witness the process. It is very interesting, both from a chemical and sanitary standpoint.

It must be borne in mind that on the side of the building where the deposits were yesterday burned the closets are used daily by some *three hundred and fifty pupils for ten months of the year*. Nothing had been done with this excreta for *two* years, and yet not the slightest odor was perceptible about the basements, closets, urinals or anywhere else.

As may be readily conceived, an immense quantity of excreta had been deposited here in the space of two years, but the fact is, very little (at least of the offensive portion of it) remained. The vaulted closet space, arched and surrounded with brick and stone, is so connected with the interior of the building and the large ventilating stack to the outside that a constant strong current of warm air is drawn over and through the deposits. The result is that the excreta become thoroughly dry and odorless, only the skeleton or solid tissues of the original matter remaining.

The excreta remaining is thus rendered very combustible. A few minutes after touching the match to *the matter yesterday the whole vaulted chamber was a mass of roaring, seething flame.* There is no possibility of damage by fire, as all the surroundings of seats, floors and walls are of iron, brick or stone.

This process of burning out the deposits yesterday was subjected to the closest inspection by the gentlemen out of the city. They were inclined to be somewhat critical and skeptical before they came to Toledo as to the means of disposing of the residue, but in a few minutes after the fire was lighted the devouring flame swept along the passage, fierce heat was generated from the dry, combustible matter, and soon nothing was left of the entire mass except a few ashes.

How vastly better it is to have these great masses of poisonous matter thus evaporated and purified by the ocean of air above and the residue consumed by flame than to have the whole pass into clogged and reeking sewers or left in privy vaults after the old fashion, to create its unwholesome stench, and be absorbed into the earth to contaminate waters and breed disease and pestilence.

These closets have now been in use in Toledo four years, and time only seems to demonstrate more fully the perfection of the system.

Mr. Smead is certainly to be congratulated upon the success of these dry closets. He rightly deserves whatever of profit and praise may come to the inventor of such a beneficent plan for disposing of great quantities of unwholesome matter.

The gentlemen who witnessed the burning-out of the dry closets yesterday expressed themselves as more than satisfied with the result.

Mr. Smead: Here is another cut representing a late improvement; in this one you will notice a brick platform extending through the vault. (See cut page 74.)

Dr. ——: This to permit air to pass both under and over the deposit?

Mr. Smead: Yes; the porous brick at once absorbs all water as soon as it comes to the vault, and then gradually gives it off as fast as the passing air can take it up.

Dr. ——: Do you find this to be a valuable improvement?

Mr. Smead: Yes, where the earth is damp, as is sometimes the case.

Dr. ——: What is the size of the vault?

Mr. Smead: Three by four feet.

Dr. ——: How rapidly does the air pass through the vault?

Mr. Smead: A little faster than five feet per second.

Dr. ——: Over 216,000 cubic feet per hour?

Mr. Smead: Yes, it will average more than that.

Dr. ——: Does the current ever reverse and malodors go back into the basement or building?

Mr. Smead: I have had but few instances of the kind, and never a back current where the engineering was properly done. Fearing I might have trouble in that way, I devised an automatic check-valve at the end of the vault next to foul-air room. Although they only cost $6 each, I soon abandoned their construction, as I found them to be entirely unnecessary.

Dr. ——— : The result would be serious if a back-set did occur.

Mr. Smead : Not very serious. It would be very annoying, but, unlike the deadly sewer gas, there would be little or no danger, as the signal is at once given, its presence being plainly noticeable, while the sewer gas is not noticeable by its odor, and is present in all buildings where plumbing is introduced.

Dr. ——— : The fact that you have gone on introducing them year after year for the same parties, for instance Toledo Board of Education, is pretty good evidence that they are all right, and especially as they are being substituted for water-closets and outside vaults.

Mr. Smead : Here is an extract from a circular written by Mr. Otis Jones, of Chicago, upon the subject, that I have always thought to be a very clear statement of the closet question. I hope you will have time to read it.

The dry-closet system, as patented by Isaac D. Smead, will convince the most skeptical of its superiority over any other system in use. Two others are practiced. The first and most common is the old vault plan, in which the vault is used until it is filled, when either the *building* is placed on a new vault and a little earth thrown over the old one, or, during the night, as secretly as possible, the contents of the vault is removed by night-soil scavengers, taken to the limits of the city, where a pit is dug, the excreta dumped in and a few feet of earth or sand covered over. There it lies for years, a festering mass of corruption, *a veritable plague-spot upon the face of the earth.* In the course of time (how near eternity the "time" may approach no one can tell), these disease-breeding particles will be absorbed and changed by the surrounding earth; but this is mainly through the action of the atmosphere and sunlight—the more deeply it is covered the slower the action, and the longer the danger continues. However horrible the *odors* may be, they are not in themselves poisons, but are notices to man, spoken in Nature's loudest voice, that the penalty for taking the poisons from whence the odors come into man's system is death.

The second plan is the water-closet system as used in most large cities. It consists in washing all the excreta in pipes, provided for the purpose, from the houses of the city into running streams, or large bodies of water where "in course of time" it becomes so dissipated by the action of the water and atmosphere as to cease to be injurious. There are two very great dangers that we encounter from the use of this system. Sewer gas is a terrible enemy to life, and it requires the work of the most skillful sanitary engineers to merely keep it at bay, as it is ever waiting for its opportunity, through careless workmen or imperfect material, to make its silent and persistent attack. The other danger is in the contamination of drinking water. The people of Chicago, or any other large city, need not be reminded how often there are epidemics of "bowel complaints." It is undoubtedly true that "winter cholera" and other similar epidemics have been caused entirely by sewage contamination in the drinking water. The recent terrible typhoid fever scourge at Plymouth, Pa., was at first a very mysterious disease, but the mystery disappeared when the drinking water was analyzed. It was taken from a small river, near the margin of which, some miles above, several privy vaults of a small town had stood for years. The filth so completely saturated the ground that it finally reached the river, thereby contaminating the water, causing great suffering to ever *one thousand people and death to more than a hundred and fifty*, as estimated by Dr. Higgins, of Wilkesbarre. He detected the typhoid germ in the water, athough it was *apparently pure.* There is a modification of the water-closet system which many scientific men, notably, George E. Waring, Jr., consider much better than the usual one we have named. This consists in having two sets of sewage pipes; one for rain-water for roofs and streets, the other for the waste from water-closets, sinks, etc. The first named goes into the river or lake, as in the former case, while the other is forced, by means of pumping machinery, some miles from the city and thrown upon the surface of a large tract of ground provided for the purpose, in some cases requiring thousands of acres for a single city. There it is left for the atmosphere to evaporate its moisture, when it becomes inoffensive and innocuous.

Now let it be noticed that in each case there is danger until the excreta has been acted upon by the atmosphere and the sunlight; and when that exposure has been free and ample, giving every opportunity for evaporation, all danger has passed from it and it is ready to be mingled with "mother earth." Mr. Duclaux claims to have recently proven, by experiments with fluids containing known percentages of germs, that *sunlight possesses a microbocide power fifty times more energetic than heat.* The following, taken from the *Sanitary News* of May 9, 1885, is only one of thousands of similar cases throughout the United States:

The authorities of a county jail in Wisconsin are considerably perplexed by a problem of drainage for their institution. The building is located on low ground, and within a few hundred feet is a so-called river, which is really nothing but a half-stagnant pond. For ten years the drainage of the institution has been directed towards this "river," through an open ditch, without reaching it. The result is that the ditch is full and its contents are spreading out over the low-lying ground. The waste is backing up under the building itself, and the prisoners, of whom there are never less than forty, are suffering greatly with sickness. The county commissioners want somebody to tell them what to do—and, of course, without cost to the county.

Since such epidemics are avoidable by avoiding the conditions which cause them, it becomes an imperative necessity to make the conditions as harmless as possible.

The old systems confined and covered all human excreta with greatest care. The Smead dry-closet system follows an entirely different course. Each inmate of a building requires many thousands of cubic feet of fresh air per day to give him life and health, and in buildings provided with our ventilating and warming apparatus that quantity is abundantly large to absorb far more moisture each day than would be necessary for each individual. By its use there is absolutely no chance for the excrement to cause disease of any kind; that the necessary apparatus, being as simple as the walls, floors, partitions and doors of the building, will be as permanent as the building itself; that there will consequently be no expense for repairs while the building stands; that when a building is erected the added expense is very small; that by its use you have no frozen water pipes preventing the use of closets; no unsightly, ill-smelling privies; no waste pipes breathing forth diphtheria, scarlet fever, typhoid, death.

Mr. Smead: Here is a letter and some enclosures I have just received from my partner in Toronto:

My Dear Mr. Smead: What helped us to get the Montreal Asylum contract was this: A neighbor to the Asylum brought suit for an injunction to compel removal of Asylum on the ground of its being a nuisance, especially on account of contaminating waters of the St. Lawrence by the sewerage. The trustees cut the ground from under his complaint by adopting the Smead system, and I was up to Montreal this week to explain the system to the court. *One of our books went in as evidence.* Mr. Radford is Sanitary Inspector of Montreal, and I think you will be interested in his explanation of "no danger from microbes."

Yours truly,

(Signed) John W. Dowd.

Sanitary Inspector Radford testified to the efficacy of the Smead system of desiccating the excreta. He had seen it in Toronto, and on his recommendation it had been adopted here. With this system there was no danger of contaminating the water supply. The Smead system of desiccation rendered the excreta hard and dry, and rendered the germs or microbes it contained harmless. If the excreta were reduced to powder and a current of air passing over it, the microbes might be carried up the ventilating shaft, but he did not believe the excreta was ever turned to powder. He believed the skin which formed over the excreta prevented the escape of germs. This skin could only be formed by a current of wind passing over it. He did not think there was any great danger from the water in which the clothes of a typhoid fever patient had been washed being drained into the St. Lawrence. The medical world was about united in the belief that typhoid is not infectious.

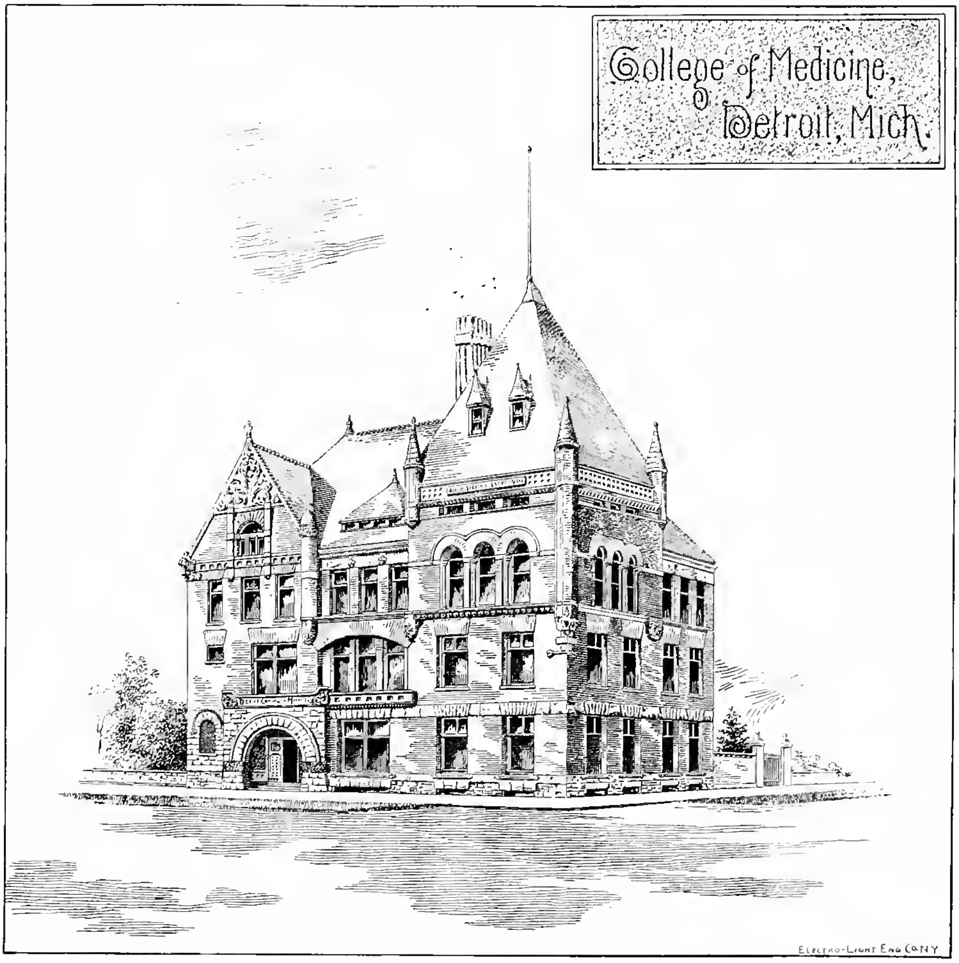
Dr. Duquet and Mr. Dutour were examined to show that no damage resulted from the erection of the hospital, and the case was then adjourned until today.

Mr. J. W. Dowd, of Smead, Dowd & Co., Toronto, manufacturers of the process for heating, ventilating and disinfecting buildings, which is being adopted by the Insane Hospital authorities, explained the nature of the system, holding that by its use the excrements were thoroughly dried up, become quite inoffensive, and could afterwards be burned. The system had been five years in use, and had everywhere given entire satisfaction.

Mr. Smead: I have hundreds of letters from all over the United States, and hundreds of printed pages of various reports made from time to time concerning our work; too many for you to read, even if you care to do so. The system is a success. There are, as I have before stated, over one thousand in use, and the only people disappointed are those interested in water-closet fixtures and some who always said it would *not* work.

Dr. ———: Didn't some of the sanitary journals attack the system a year or so ago?

Mr. Smead: No, not as their own matter; they only printed some communications written by the class I refer to. The Detroit Board of Education, after a very thorough investigation, had adopted my system of warming and ventilation for five school buildings, and to "stop dat foolishness" parties interested in heating apparatus and plumbers' supplies commenced an attack upon us through the local press, and some of the most outrageous lies were printed that it has ever been my fortune to read, or misfortune (as I then supposed), to contradict. The Board appointed a committee of doctors to aid them in another investigation, and we have since then furnished apparatus for every school building either built or repaired in Detroit, including the new Medical College.



MORTIMER SMITH & SONS, ARCHITECTS, DETROIT, MICH.

Fourteen school buildings in Detroit warmed and ventilated by the Smead system.

and the advertisement we received, instead of being a misfortune, turned out to be of great benefit to us. You must remember, doctor, that in all large cities there are, and always will be, hardware dealers selling steamfitters' and plumbers' supplies (most of the latter now put up a sign "sanitary plumbing"—it is fashionable). These have always been opposed to our securing contracts where they pay taxes. I say pay taxes because nine-tenths of our work is on public buildings paid for by taxpayers. Haven't we talked enough on the question of dry closets ?

Dr. ———: About enough to convince me that they are better than water-closets : there are some points upon which I desire further information.

Mr. Smead : Without further talk now on the subject, I would suggest that we go to one of our public school buildings and examine it in detail. I will select the last one erected, as it contains all our latest improvements. This is fair, as your verdict is to be upon our present methods, not on something done some time in the past.

Dr. ———: Is the building you select one in which your methods have been introduced upon plans that in every way meet your approval ?

Mr. Smead : Yes, and I want you to find all the fault with the work that you can.

Dr. ———: Can I take with me apparatus to test the quality of the air, uniformity of temperature, etc.?

Mr. Smead : Certainly, and I further agree to publish and circulate whatever your report may be.

Dr. ———: You seem to have implicit confidence in the result, and I give you notice now that the examination will be thorough.

Mr. Smead ; A year ago I was requested to "read a paper" at a convention of doctors. Here is what I said ; the statements I made then I still adhere to :

If all or one-half the questions that an engineer has to decide in preparing plans for a building were thoroughly understood, the criticisms would be much less severe. It is reasonable to expect substantially as follows:

1. That the apparatus be reasonable in its cost.
2. That it will consume the kind of fuel cheapest in the district in which it is to be used.
3. That the apparatus be easily managed.
4. That it shall be so constructed and so located in the building that no heat generated by the fuel consumed is lost.
5. That with a reasonable amount of carelessness and neglect the apparatus shall be durable.
6. Easily repaired if broken.
7. Almost automatic in its operation.
8. Absolutely free from danger, either by fire or by explosion.
9. That it shall take the air from that portion of space occupied by the inhabitants of the earth and send it into the building uninjured by over-heating.
10. The building should be so arranged that, at the will of the teacher (if a school building), air at any temperature desired can be secured with little effort.
11. So arranged as to avoid local or unpleasant currents of air.
12. So arranged that the temperature will be uniform.
13. So arranged that the floor will be warmed and an unequal temperature between head and feet avoided.

Now, these are a "baker's dozen" of specifications, and I believe that no reasonable person will ask for many more. There are in this city over twenty school buildings in which nearly all these specifications are filled to the letter, and some buildings wherein all are to be found. And as I have said to your chairman, I

State Board of Education.
Otsego, Mich., February 8, 1889.

Isaac D. Smead & Co., Toledo, Ohio:

Gentlemen,—Being a practical builder and a school man, I have been much interested in making a thorough examination of your heating, ventilating and dry closet system, and it gives me pleasure to bear testimony to its excellency. The heating apparatus or furnace is simple in construction, easily adjusted, and warms a building quickly and well. The ventilation is a success in every respect, and the dry closet is the only system that I have examined in any school building which is without objections. The whole arrangement is perfect, and I recommend the entire system, as furnished by your firm, to builders of school-houses, churches, halls and city blocks. Very truly yours, J. M. Ballou, *Pres't State Board of Education.*

was not going to theorize, or try to impose upon you a scientific essay. I could not do so if I would, and would not if I could; but rather call your attention to the *practical* side of the question. I will ask you to come, after adjournment, to one of the buildings referred to and see for yourselves whether the statements are true or not. If in your opinion they are not, I hope you will not hesitate to say so. If they are true, will you not lend me your assistance in suppressing the fiends who declare that "no one has yet solved the problem?" And while we are about that business, let us also include those who always write and advise, but never *do* anything else.

If you accept my invitation I will take you to a school building cared for by a woman janitor, and show you schoolrooms in which the air is changed every nine minutes, and where the teacher can secure air through the register at any temperature between January and August; where the floors are warmed, as all air exhausted from the rooms passes under them on its way to the ventilating stacks, via the dry closet vaults in the basement. To describe these vaults, I will simply use the language of Hon. J. J. Clark, president of the Canton, Ohio, Board of Education, who came here to examine them, and who, in his report, says:

> The members of the committee confess that these results created in their minds a deep and profound sensation. Here was a system of closets sufficient in capacity to accomodate six hundred pupils, in constant use four months, at an original cost of not to exceed $150, in perfect condition, with no noisome odors, no unsightliness, no pipes, no water-works, no plumbers' appliances, no sewerage system, no loathsome and disease-creating cesspools, no stifling disinfectants, nothing but a free and unobstructed circulation of God's atmosphere, which had already performed the double and important functions of heating and ventilating the rooms in which five hundred children had been engaged in their school work.

Now, if Mr. Clark has told the truth, and if others who have written upon the same system and in the same manner have told the truth, why need the theorist and professional writer whine and sigh for something "better?"

Dr. ———: Did you have some trouble at Cleveland?

Mr. Smead: Yes, with the newspapers. Here is an interview published recently that will tell the whole story; please read it:

"What is the matter with the Smead system in the Cleveland School building?" asked a *Blade* reporter of Hon. Isaac D. Smead, whom he found in his new office building on Huron street.

"Nothing now."

"What has been the trouble there?"

"There has been no trouble with the 'Smead' system of heating, but in one building there was a serious defect in the application of my system of dry closets. I suppose you have been reading the Cleveland *Leader*," replied Mr. Smead, with a smile.

"Yes, and the *Blade* would like to know the facts in the matter."

"Then I will have to tell them, for you cannot get them from the *Leader*, if I can judge by what they have printed."

"Have you done much work in Cleveland?"

"Yes, both for the Board of Education and in other public buildings. Briefly, the facts are these: Several years ago the Cleveland Board of Education wasted a very large sum of money in heating apparatus, having a large number of fine buildings.

"One morning, two years ago last summer, three gentlemen came into my office and were introduced as a committee from the Cleveland Board to investigate my apparatus for school buildings. After examining into the matter with what seemed to be more than ordinary care, they contracted with me to furnish apparatus for the Eagle Street School building, and returned home on the afternoon train.

"The apparatus was used during the winter of 1886-87. During the spring of 1887, while in Washington City, my attention was called to an attack upon me and my apparatus published in the Cleveland *Leader*. I went down to the newspaper offices, and by examination of the Cleveland papers learned for the first time that at a meeting of the Cleveland Board of Education the Building Committee had been instructed to introduce the 'Smead system' into all of the new buildings, some five or six in number. Our contract amounted to some $25,000.

"I was fairly entitled to the contract, because of the successful and satisfactory operation of my apparatus in the Eagle street building, and also in the West Cleveland School building. Of course I was pleased at the action of the board; but I was also being injured by the *Leader* articles."

"What did you do?"

"I finished my business in Washington, came home and asked the *Leader* to send a reporter to interview all the teachers in the Eagle street building (nine in number). This it did, and also interviewed the members of the West Cleveland board, and Mr. Teachout, chairman of the Building Committee of Hiram College, who resides in Cleveland. I have since published the interviews among my testimonials. Every statement made was contrary to those which the *Leader* has been publishing. *They printed the interviews and charged me 50 cents for every line printed.*"

"Did you pay the bill?"

"Of course I did. A man is very foolish to quarrel with an editor if it can be prevented. The advantage is all on the editor's side; and the poor contractor is the legitimate prey of the newspaper man."

"How do you know?"

"Twenty years of experience teaches a fellow some things he don't soon forget."

"As a newspaper man I cannot agree with you; but what about the recent trouble?"

"Just this: the work done in 1887 was entirely satisfactory to everyone except disappointed competitors and their friends; and the board again contracted with me to furnish apparatus for two more buildings. One of these—the High School building—was erected a good many years ago. It contained a steam-heating apparatus and four large ventilating stacks. In these stacks there were steam coils and pipes designed to keep the stacks hot and make them 'draw,' notwithstanding the fact that the stacks were *twenty-one feet lower than the highest portion of the roof.* Although we were assured that 'there had never been any down-drafts,' we hesitated about connecting the closets with them; but my superintendent finally did so, although against the protest of my engineer.

"The system operated successfully until some three weeks ago, at which time there was a severe wind-storm in Cleveland, and the wind struck the roof in such a manner as to glance off and go down the ventilating flue. The result was just what my engineer had anticipated.

"The superintendent of buildings wrote me; I went over and saw the building for the first time. It was plain to me that the error was ours, and could be corrected by an extension of the flues to the proper height. This I did by an addition of 23 feet to each chimney, and now the harder the wind blows the better the draft, and the meter records an exhaust of 723,000 cubic feet per hour from the building.

"The members of the committee were so well satisfied that they at once recommended that the other two stacks (with which we had nothing to do) be extended to the same point at which I stopped mine. It has also developed that the position taken by Prof. Campbell, principal of the school, is correct, namely, that until now the building has never been ventilated at all; and he strongly urged the extension of the other two flues.

"With water-closets the poisonous sewer gas escapes constantly to a greater or less degree, and, although very poisonous, has but little odor; while with my system there can be no sewer gas, and if anything is wrong the odor gives the signal at once."

"You spoke of being in Washington; are you doing work there?"

"Yes, between January 1, 1883, and January 1, 1888, I introduced my apparatus into twenty-four school buildings there, and am now executing contracts there on nine more school buildings for the district commissioners."

"How do you, a republican, hold on under a democratic administration?"

"Politics have nothing to do with the engineering department, so far as I have ever observed, under any administration."

"Who will be the next president?"

"Harrison, I hope. But what has that to do with troubles in the Cleveland school buildings?"

"Is the Cleveland board democratic or republican?"

"I never heard a member of the board mention politics; but I understand the democrats have the majority."

"Has that anything to do with the *Leader* articles?"

"I don't know. I notice that they abuse the board for about everything it does."

"What are you going to do about it?"

"Nothing. I do not have to pay 50 cents per line now, and I hope the articles will do me as much good as did those of the Detroit *News* last winter. Since the attack of the *News* commenced I have had all the contracts awarded there—eleven large buildings."

"Do you often have trouble with your work?"

"I do the most work in my line of any man in America. I never have trouble with either my customers or my apparatus, except occasionally because of mechanical errors, as my workmen are not all *perfect.* But I always have trouble with my competitors, and in large cities it is worse than anywhere else. The worst fight I ever had was the one at Columbus. There the Pittsburgh, Cleveland and Columbus steam-heating men combined against me, and we got into the courts. The other side had the costs to pay, and the Columbus board has introduced my apparatus into seven buildings, in addition to the four I had when the fight commenced."

* * * * * * *

Mr. Smead: Well, doctor, here we are again. You have been interviewing me for the past ten days; I now want to ask *you* a few questions. Did you examine the Segur Avenue School building, and did the janitor know very much about the merits or demerits of the machinery under charge?

Dr. ——— : Seemingly very little.

Mr. Smead : Do you suppose the teachers appreciate the comfort and healthfulness of the rooms they occupy?

Dr. ——— : I have found a number who do.

Mr. Smead : I am glad of it, they are generally very hard to please; I gave up trying it long ago.

Dr. ——— : Who do you try to please when you put up a heating and ventilating apparatus?

Mr. Smead : Only the purchaser and myself. Myself first.

Dr. ——— : Is most of the work you do done in public buildings?

Mr. Smead : Yes; our apparatus is suitable for schools, churches, opera houses, court houses and residences, although for the last ten years I have done but little with the latter.

Dr. ——— : What was the amount of your sales the first year after establishment of business in Toledo?

Mr. Smead : Twenty-two thousand dollars the first year; over $500,000 the seventh.

Dr. ——— : By your card I see that you have other offices besides at Toledo.

Mr. Smead : Yes, at Elmira, N. Y., at Philadelphia, at Kansas City, at Boston, at Cincinnati, at Washington and at Toronto, Canada. The gentlemen associated with me in these offices were former employés in this office. They are skilled engineers, honest and faithful men, men whom their customers have learned to respect and honor; and it gives me more pleasure than I can find words to express to know that, although to a degree I was instrumental in their early start in business, the confidence I have reposed in them has in no instance been betrayed. The skill they possess is not excelled by any now remaining here. They have had a "hard row to hoe"; hot-air furnace men, steamfitters and plumbers opposed them at first, and *the pirates of late steal and copy all they can.* Architects, or some at least, anxious to have it understood that no plan is right except their own, or fearing some credit may fall to some one besides themselves, or with some experiment to try, oppose them; but the gentlemen labored on in spite of all obstacles, until there are now scattered all over their territory monuments in the form of breathing buildings — monuments to their industry and skill that will last many years after those who would now steal from them all that is not covered with patents (and they often infringe on those) have long been forgotten.

Dr. ——— : Don't you have patents to protect your invention?

Mr. Smead : Yes, but no inventor gets full protection from the *thief.* Here is an extract from a brief recently submitted in one of my cases by my attorneys (Dodge & Son, Washington, D. C.). They seem to know something about the troubles of a manufacturer who tries to make improvements.

Between the ingenuity of the pirates, aided by the present strict construction of the courts, on the one hand, and the dictation of claims by examiners on the other hand, the inventor of today finds it next to impossible to secure by a patent that protection of his invention which the law was designed to afford him. This being so, the office should not place unnecessary obstacles in the pathway of *a class of men* who, as Commissioner Fisher, in his report to Congress, says, "*have done more for the glory and prosperity of the United States than any others, and who have never been favored children.*"

The action in this case was well described by Commissioner Fisher as the "unfriendly hand of adverse criticism," and which, as he states, "if it had been applied to most or all of our great inventions when first presented to the office or the public, *would have strangled them at birth.*"

The spirit which should actuate the office in all its branches was beautifully expressed by Commissioner Holt, in the case of D. D. Badger, rejected on a technical objection, wherein he said:

"If, however, the stringent construction now favored in certain quarters be adopted in practice, it is to be feared that many inventors who have been summoned to this office by the constitution would find its doors shut in their faces.

"It is due to the dignity of the subject and to the generous spirit of the constitution that the patent laws should be liberally construed, having ever in view the great end they were designed to subserve. They were enacted for the government of an office whose range of action is altogether *above the barren field of mere technicalities.* That office, in my judgment, would be forgetful of its mission and disloyal to one of the highest interests of humanity were it to permit itself to be entangled in a mesh of mere words or palsied by doubts born of intricate metaphysical disquisitions. *It has to do with the substance of things, and to deal with the earnest, ingenious, practical intellect of the age, and it should deal with it frankly, not perplexing and discouraging inventors by subtle distinctions, but kindly taking them by the hand as benefactors of their race, and strewing, if possible, their pathway with sunshine and with flowers.*"

Mr. Smead: There is a great deal said about the health of our school children. Before entering upon a discussion of the inspection requested at my last interview, it may be well to bring out a few points in regard to school life. Do you think that the health standard of school children is improving?

Dr ———: That question can scarcely be answered in a few words; but I think that, taking all things into consideration, the physical standard of school children is being lowered.*

Mr. Smead: To what do you attribute this degeneration?

Dr. ———: There are many factors that are influential toward this end. The first seeds of premature break-down are sown during the growing period. The forcing system of education, lack of proper physical training, combined with *unwholesome schoolrooms*, are largely accountable for imperfect development; and thus do multitudes of youths enter on life's work handicapped by physical weakness.

Mr. Smead: I can see signs of beginning reform in one feature that you have mentioned. Schools of manual training embody my idea of a perfect educational system; and more attention is being given to physical training, is there not?

Dr. ———: You are quite right, but it is no easy problem to stem the tide of degeneracy. An imperative duty devolves on every school board and corps of instructors having youth in their care. The laws making *education* in any way *compulsory* at the same time impose on the public servants assuming control of school property a serious obligation.

Mr. Smead: You refer to providing *wholesome schoolrooms* and *surroundings?*

Dr. ———: That is the duty of every board of education. We cannot afford to train our higher faculties at the expense of our general physical welfare. That is what we have been doing for too many years.

Mr. Smead: What do you regard as the essentials of a wholesome schoolroom?

Dr. ———: A comfortable temperature and pure air. There are many other features not necessary to enumerate, but there is a broad field for reform work in the above.

Mr. Smead: It is not so difficult to maintain a comfortable temperature, but the pure-air problem is not a simple one, as I have learned from observation and many costly experiences.

Dr. ———: It has been worked at for a century, and what is the result? A general distrust of all methods and an educated indifference toward the pernicious influences of breathing impure air. The spirit of the times demands an energetic reformer — one who can force the indifferent to see the error of their ways; stimulate in them the spirit of inquiry; give them a few *object lessons.*

Mr. Smead: By object lessons you mean the inspection of a practical operating system of ventilation, do you not?

Dr. ———: That is just what I refer to. The *personal inspection* of a perfect system of ventilation and warming is a most potent public educator. The contrast between *perfect ventilation* and *no ventilation* is as *light* to *darkness*, and those who are too indifferent to choose the former can make no better bequest to the world than their own ashes.

Mr. Smead: You are quite right, doctor, when you say that personal inspection is a powerful argument where there is real merit in the thing inspected.

Dr. ———: The superior merit of your system has enabled you to fearlessly provoke public criticism, confident of a favorable issue?

Mr. Smead: Public criticism has almost invariably resulted to our advantage: what is the result of *your* inspection at the Segur Avenue School building? What were your first impressions on entering?

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* Preyer states that one-fourth of all students are injured physically by the educational process; 60 per cent of the students are physically disabled and unfit for life's work.—*Congress of Physicians and Naturalists, Wiesbaden.*

Dr. ——— : The temperature in the spacious halls was about the same as that of the rooms. The thermometer did not vary three degrees from 72° in any part of the rooms. The atmosphere was perfect, in as far as the senses can judge, on the days of my inspection.

Mr. Smead : To what extent can the senses be depended on in investigations of this character ?

Dr. ——— : Elaborate experiments by Dr. de Chaumont prove that the organic constituents of expired air corresponding to carbonic acid gas to the amount of .4 parts per 1000 *above* that in the normal air (.35 per 1000) can be detected by the educated senses.

Mr. Smead : Our senses are then capable of giving us reliable warning, under favorable circumstances, as I understand, when the accumulation of respiratory products has reached a deleterious amount.

Dr. ——— : The evidence of our senses, referring to those who have these faculties unimpaired, is to all practical purposes reliable, in so far as most of the natural gases of decomposition are concerned. There are poisonous gases developed in certain artificial filth reservoirs, as, for example, sewers, of which our senses give us no warning. I regard the *sewer*, as ordinarily constructed, as the most pernicious of all the features that mark the *era of city building*, since it becomes a vast reservoir for accumulation of the gaseous products of putrefaction of which the pipes entering the houses are the highest portion, and consequently the most natural outlets for such gas. But they are dangerous chiefly because the gases so generated are those against which man has developed but little resisting power. We are all well aware how much ordinary above-ground stench and filth the human system is capable of withstanding. Nature has developed a certain amount of resisting power, and has cultivated in us a faculty that can warn us of such deleterious influences ; but the sewer and its own peculiar products of decomposition is a concomitant of modern civilization, and man has not as yet developed a resisting power to withstand their injurious influences ; nor have we even a faculty capable of warning us of the presence of these dangerous gases. Not only general debility may follow the breathing of sewer gas, but most of the zymotic diseases, as diphtheria and scarlet fever, are aided in their work of destruction, and epidemics of typhoid fever have been traced directly to the presence of sewer gas.[*]

Mr. Smead : Then would you say, doctor, that the odors coming from decomposing human ordure are not injurious in proportion as they are disagreeable ?

Dr. ——— : I do not mean to say all of that, but I can assert that I should prefer to risk my health working as a scavenger, carting off above-ground filth, than to be compelled to live where emanations from a sewer more or less constantly (and without the warning of our senses) contaminate the air.

Mr. Smead : You feel that your system can resist and throw off the emanations from ordinary putrefaction, but you fear the gases developed in underground reservoirs where there is absolutely no change of air from one year's end to another, and poisonous gases become concentrated and ever more and more virulent ?[†]

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[*] See paper read before Hygienic Congress of Vienna, 1887, by Prof. Brouardel ; and Epidemic of Typhoid Fever in Michigan State's Prison, Jackson, by Prof. Vaughan.

[†] Dr. H. J. Herrick, Professor of Hygiene in the Medical Department of Western Reserve University says : "The relative capacity of air and water for destroying noxious elements and for purifying might be a matter of some question. The atmosphere has, to my mind, a very much greater capacity for destroying and diffusing the noxious germs or noxious gases than the water. According to authoritative statements sewer water has a capacity for discharging an almost illimitable amount of noxious vapor wherever it is found. Dr. Letheby found that sewage water excluded from air and containing 128 grains of organic matter per gallon yielded one and two-tenths cubic inches of gas per hour during a period of nine weeks. The peculiar fetid smell of sewage gas is owing to the presence of organic matter whose exact chemical composition has not been determined. It is believed by some to be carbo-ammoniacal. According to Dr. Cunningham it contains distinct bacteria and other low forms of cell life. Now, water has a capacity, especially running water, for purifying itself. It is claimed, as I remember it, that a distance in rivers of twenty miles is sufficient to render running water comparatively pure from sewers entering the river above. I am not certain as to the distance, but that is a fair estimate. The methods by which the water is purified are by animals or plants in the water, by the action of oxygen upon the organic matter, that is, aeration, by the diffusion of the noxious material and by sedimentation. The methods of purifying the atmosphere from its noxious gases and elements are : By the rapid diffusion of the gases in the atmosphere, by the action of oxygen which is always ready to consume—especially where there is any amount of ozone it is active for the destruction of organic matter—and, coincident, is the action of vegetable life, which rapidly consumes by an appropriation of carbonic acid gases, and, it is supposed, also of mephitic gases. These are the natural methods by which the atmosphere is kept free from gases or conditions unfavorable to animal life."

"According to a well-known law the diffusion of gases is in a still atmosphere proportioned to the square of the distance. Currents of air, winds, vastly increase the rapidity of the diffusion. Gases discharged into the atmosphere the height of the high school stacks are very rapidly diffused. Bear in mind that the contents of those closet vaults are comparatively small. There are perhaps 500 evacuations in each twenty-four hours. It must be seen that the vapors from these contents are very rapidly diffused and that they are not a perceptible factor for rendering the atmosphere impure."

Dr. ——— : That is a concise statement of my belief, and recently adopted systems of sewerage, as for instance the Waring system, recognize this fact and reduce as much as possible the danger from accumulation of gases by reducing the size of the sewer to the actual volume of solid excrementitious material to be disposed of.

Mr. Smead : To return to our original theme. You would say that the absence of any odors in a schoolroom to one coming from the outer air is proof that the air is wholesome.

Dr. ——— : This is certainly true, but the converse does not necessarily hold. The presence of odors does not always indicate a positively unwholesome air. There are so many sources of human odors that it is almost impossible to keep a schoolroom absolutely odorless. The home life of many school children is such that the clothing often becomes saturated with the odors of the close living-room or still more fragrant kitchen, and a few uncleanly children can contaminate the air of a whole room.

Mr. Smead : You regard the organic gases as *the* deleterious constituents of breathed air. What part does carbonic acid gas play as a gaseous excreta?

Dr. ——— : It is conveniently used as an index of respiratory impurity, being much easier of determination than organic matter ; but it is harmless as compared with the organic matter in suspension in watery vapor and organic gases, and it is very diffusible and does not accumulate so readily. Diffusion is constantly going on, and the air of a room may be thus freed from much of the carbonic acid gas ; especially in poorly constructed buildings where there are many cracks and crevices left by the "*sanitary*" carpenter !

Mr. Smead : But obviously this watery vapor is not so diffusible as the carbonic acid gas, and the air of a room is less easily freed from it. I should think that it would be liable to accumulate wherever the air stagnates, and especially on all cold surfaces, since saturation of the air varies with the temperature.

Dr. ——— : That is just what does take place. The amount of watery vapor, more or less saturated with organic matter in suspension and organic gases exhaled by every adult, is about nine ounces in twenty-four hours. It may be asserted that *the object of a ventilation system should be to relieve the air of a room of the organic constituents* and prevent deposit by strong, constant out-going currents of air. There is just this difference between a well-ventilated room and one poorly ventilated. The one constantly filled with Nature's purest, the other a reservoir receiving daily the deposit of a putrescent sediment on walls and ceiling until it becomes a place suitable only for the myriads of minute organisms, whose sole reason for existence is to haunt the abodes of higher forms of animal life and thrive and multiply on the products of decomposing organic matter. If the condensed breath collected on the cool window panes of a room when a number of persons have been assembled be burned, a smell as of singed hair will show the presence of organic matter, and if the condensed breath be allowed to remain on the windows a few days it will be found, on examination by microscope, that it is alive with *bacteria* and *animalculæ*. It is the inhalation of air containing such putrescent matter which causes half of the sick headaches which might be avoided by a circulation of fresh air.

Mr. Smead : Doctor, have you ever made any chemical tests of the air in rooms ventilated by my system ?

Dr. ——— : I have, and can present one series of such observations in a tabulated form.

On May 11, Hon. E. G. Hubbard, President Board of Education, Tiffin, Ohio, writes: "In reply to your favor of the 9th inst., beg to say that with my experience in examining the practical workings of the different systems of heating and ventilation, I am most decidedly in favor of the Smead over any other now before the country, for it has certainly given us eminent satisfaction. In regard to the dry closets you speak of, I inclose explanatory letter from our superintendent, Mr. J. W. Knott, who has been with us ever since the first introduction of the Smead system in our school buildings."

The following is from the letter of Superintendent Knott referred to above:

"I think you can safely indorse the system of dry closets put in by Smead & Co. In any building in which there is any means of causing an upward current in the ventilating flues of the vaults, the closets cannot fail to give satisfaction. In our new building they come as near doing their work perfectly as anything of the sort which I have ever seen."

TABLE No. I.—Table of Chemical Analyses, Actual Velocity of Air and Cubic Feet per Hour.

Number of room.	Exposure.	Cubic contents.	No. of pupils.	Cubic feet room space per capita.	Date.	CO_2 per 1,000 parts.	Temperature in room.	Temperature outside.	Temperature of warm air.	Outside humidity.	Room humidity.	Linear feet per minute at register.	Area of register.	Cubic feet per hour.	Cubic feet per hour per capita.	Comments.
First Floor.		*Cu. ft.*														
No. II	N.W.	9,000	26	346	II, 23	(1) .55	75°	Mild.	......	..	...	....	....	......	....	
No. III	N.	11,000	56	190+	III, 2	(1) .40 (2) .45	74°	50°	......	...	...	....	....	......	....	
No. IV	N.E.	9,000	45	....	III, 8	....	....	58°	111°	85	...	600 lin. ft.	2.5 sq. ft.	90,000	2,000	Changes air in room every *six minutes.*
No. V	S.E.	9,000	43	200+	II, 24	(1) .49 (2) .56	72°	30°	......	...	...	....	....	......	....	
Second Floor.																
No. VI	S.W.	9,000	52	170+	II, 22	(1) .37* (2) .50	70°	Mild.	......	...	...	....	....	......	....	*Flasks filled near direct draft from register.
No. IX	N.	11,000	37	300—	II, 27	(1) .35 (2) .345	72°	24°	......	...	...	....	....	......	....	Only 37 present, and of these 17 had just entered.
No. IX	N.	11,000	44	250	II, 28	(1) .432 (2) .428	70°	32°	......	...	...	....	....	......	....	
No. IX	N.	11,000	50	220	III, 8	....	74°† 73°	45°	111°	85	84	675 lin. ft.	2 sq. ft.	81,000	1,620	†74° at ceiling; 73° at floor.
No. X	N.E.	9,000	40	225	III, 8	....	(60°)‡	58°	58°	...	...	290 lin. ft.	2 sq. ft.	34,800	870	‡School dismissed; fires quite low.
No. X	N.E.	9,000	40	225	III, 8	....	70°	45°	80°	85	72	570 lin. ft.	2 sq. ft.	68,400	1,710	
No. X	N.E.	9,000	40	225	III, 8	....	75°	43°	111°	...	...	650 lin. ft.	2 sq. ft.	78,000	1,950	Fires good.
				8⌊1,901		11⌊4.875	10⌊725°	......	......	...	...	....	....	......	....	.443 CO_2 per 1,000 av.
				Av.=237+		Av.=.443	Av.=72°	......	......	...	...	....	....	......	....	72.5° F. average tem.
							Tem. chamber.					*Lin. ft. min.*	*Area outlet.*			
Foul-air chamber	N.W.	......	...	....	II, 26	(1) .417 (2) .35‡	52°	45°	......	...	...	....	....	......	....	‡School just dismissing; hall doors op'd
Foul-air chamber	N.E.	......	...	....	III, 8	....	61°	58°	......	...	...	225 lin. ft.	6.5 sq. ft.	87,750	....	

(From Proceedings of the Ohio State Board of Health, 1887.)

Explanation of Table No. 1.—In all cases the air analyzed was collected after at least three-quarters of an hour continuous session. Number of pupils refers to number actually present on day of analysis. Carbonic acid estimate: (1) and (2) refer to the two analyses made in each case. "Temperature of warm air" refers to temperature of air entering at register. "Linear feet per minute," at register, was determined by anemometer. "Area of register" means actual area less iron grating. "Cubic feet per hour" refers to air entering at register. Average of eleven analyses in rooms, .443 CO_2 per 1,000; maximum difference between two analyses conducted at same time, .13 (one flask was filled near draft from register). Linear feet per minute by anemometer at register ranges from 290 (temperature 58°) to 675 (temperature 111°), giving 34,800 and 81,000 cubic feet per hour. Average cubic feet per hour at register (4 trials, temperature between 80° and 111°), 79,350 cubic feet. Average attendance, 45—gives 1,700 cubic feet per capita each hour.

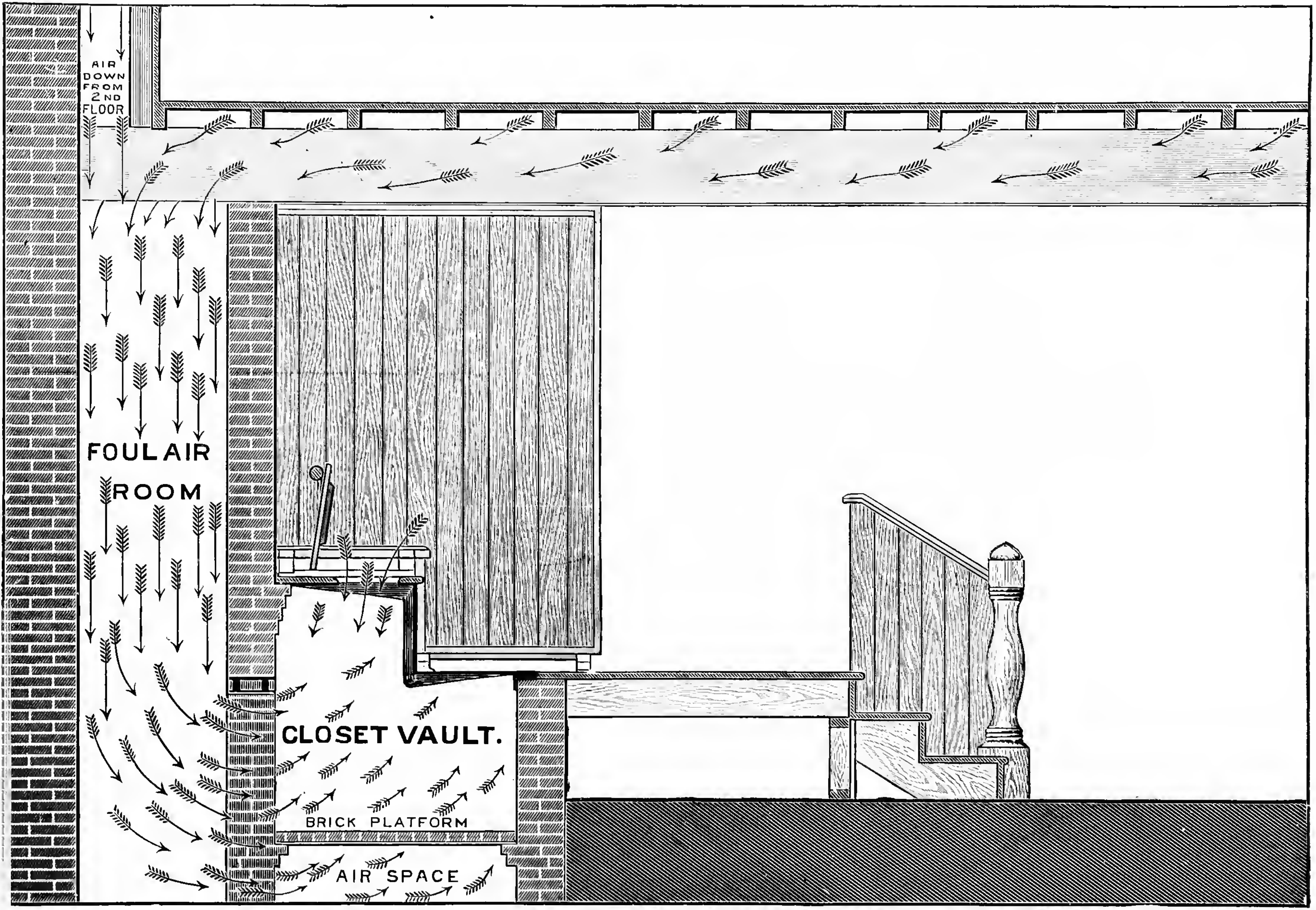
TABLE No. II.—ESTIMATES OF CAPACITY OF SHAFTS, ACTUAL TEMPERATURE TAKEN AT 6 FEET AND 30 FEET FROM OUTLET.

	Ventilation Shaft.	Section area.	Height.	Average temperature.	Outside temperature.	Difference.	Velocity in feet per second.	Deduct 5-12 for friction.	Cubic feet per second.	Cubic feet per hour.	Cubic feet of room ventilated.	Amount, in cubic feet per hour, for each 200 cubic feet of room space. (Each pupil has about 200 cubic feet.)
1	N.W.......	8.33 sq. ft.	62 ft.	(44°-52°) 48°	21°	27°	14.72=	8.62	71.79+	258,400+	23,500	2,100 cubic feet.
2	S.E.........	8.33 sq. ft.	48 ft.	(47°-53°) 50°	20°	30°	13.68=	7.98	66.47+	239,300	27,500	1,700 cubic feet.

ASSUMING AN AVERAGE DIFFERENCE OF 10° BETWEEN AIR IN SHAFT AND OUTSIDE.

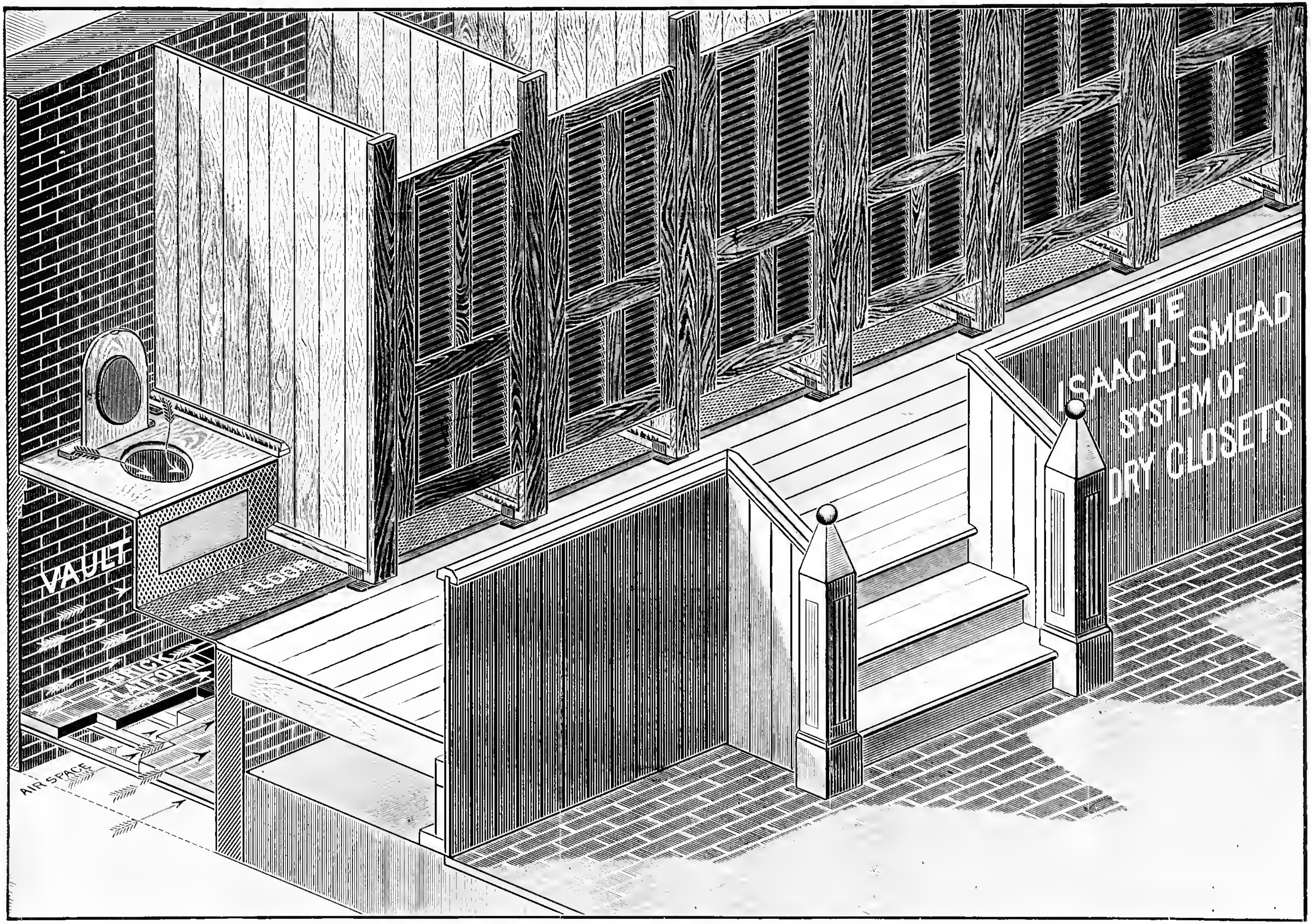
					Av. tem. 10 mo., 1886.							Number of cubic feet per capita each hour, 168 enrolled.
3	N.W.......	8.33 sq. ft.	62 ft.	53.8°	43.8°	10°	8.96	5.23	43.56+	156,800+	23,500	
4	N.E.........	8.33 sq. ft.	62 ft.	53.8°	43.8°	10°	8.96	5.23	43.56+	156,800+	23,500	
5	S.W	8.33 sq. ft.	48 ft.	53.8°	43.8°	10°	7.84	4.59	38.23+	137,500+	27,500	
6	S.E.........	8.33 sq. ft.	48 ft.	53.8°	43.8°	10°	7.84	4.59	38.23+	137,500+	27,500	
										588,600	102,000	1,200+ cubic feet.

Estimates in table "Assuming an Average Difference of 10° between the Air in Shaft and Outside Air," based on Montgolfier's formula.

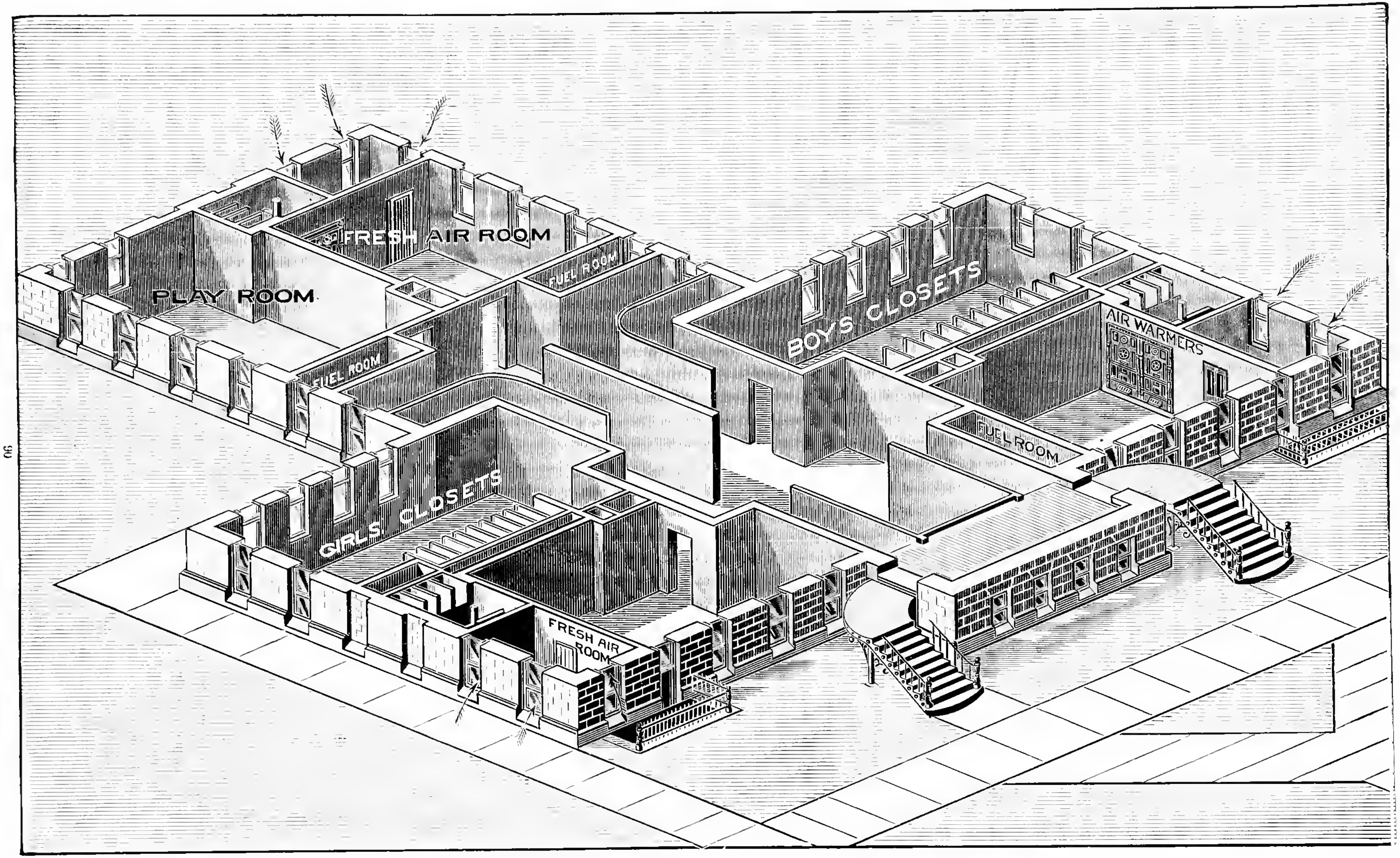


SECTION THROUGH DRY CLOSET VAULT AND FOUL-AIR ROOM, SEGUR AVENUE SCHOOL BUILDING, TOLEDO, OHIO.

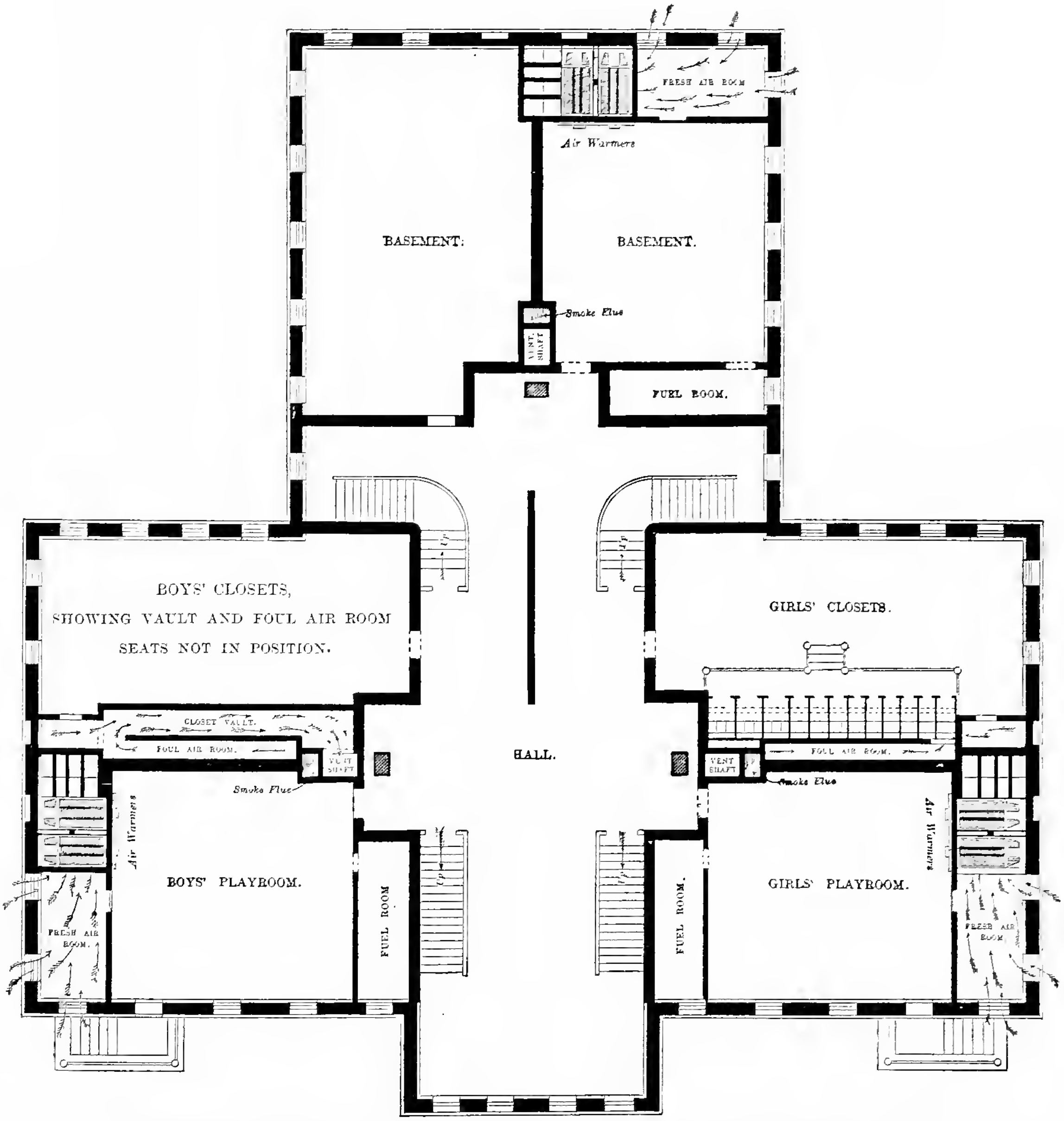
Designed and patented by Isaac D. Smead.



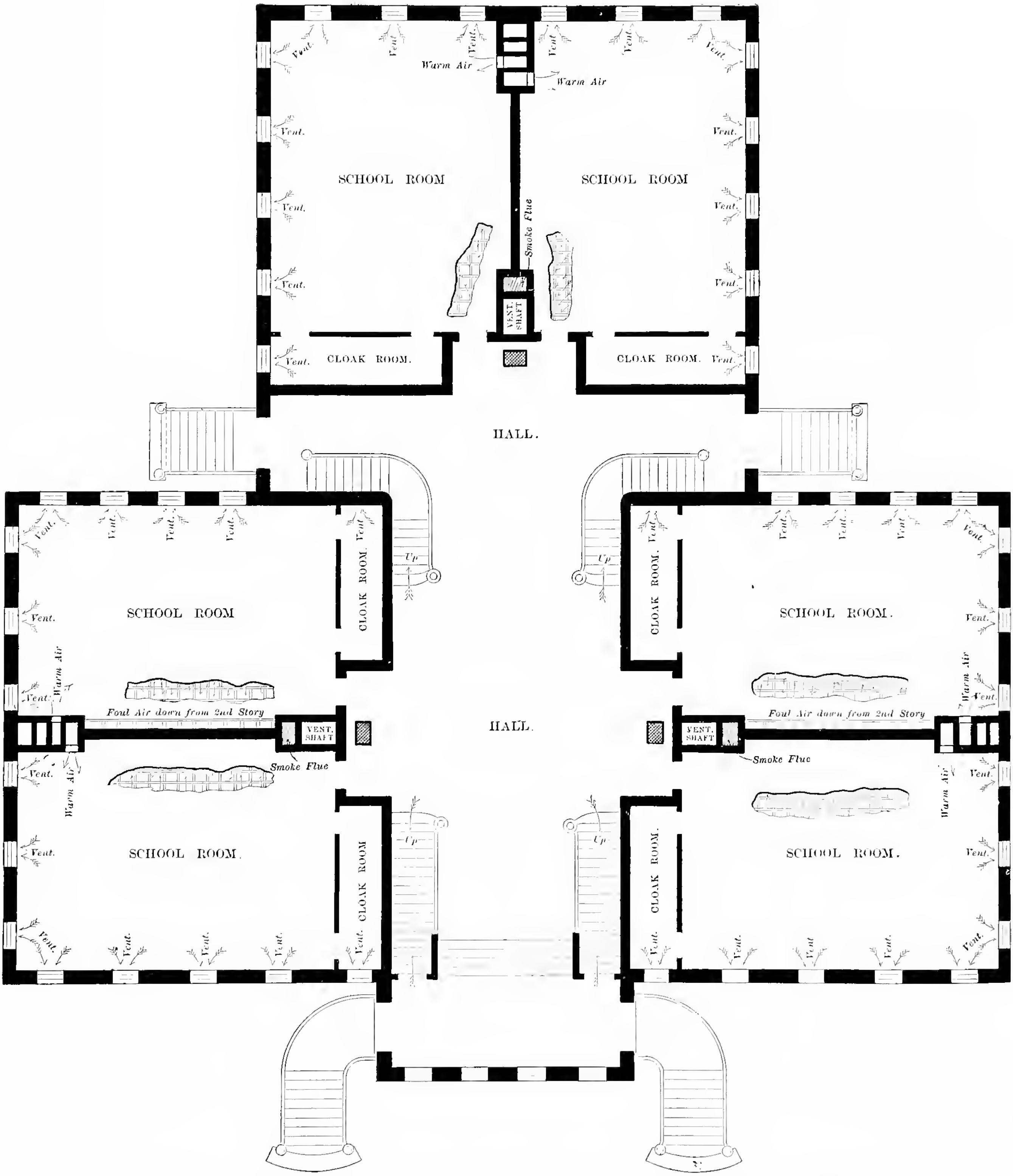
PERSPECTIVE VIEW OF THE ISAAC D. SMEAD SYSTEM OF DRY CLOSETS.



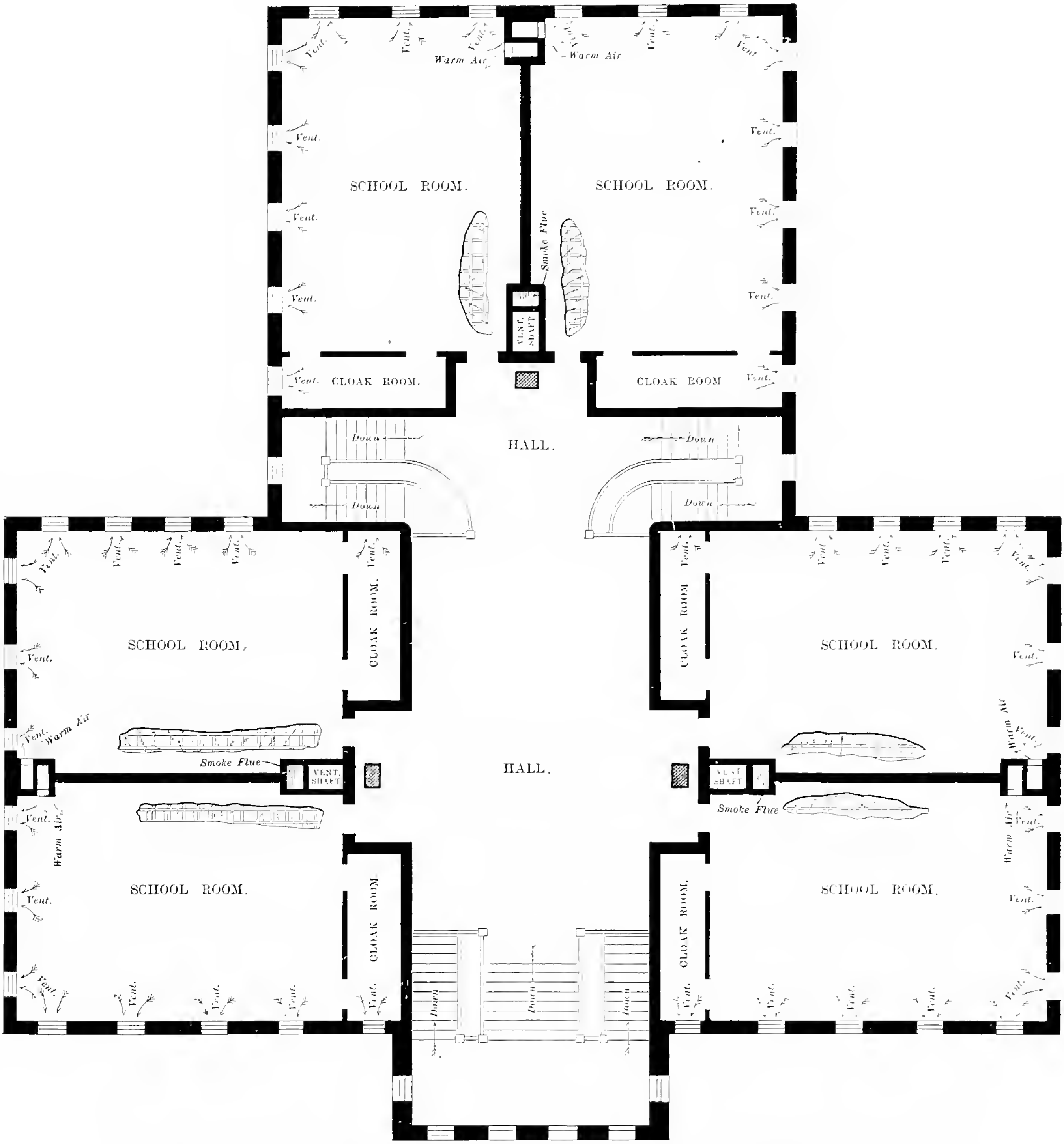
BASEMENT SEGUR AVENUE BUILDING, TOLEDO, OHIO.



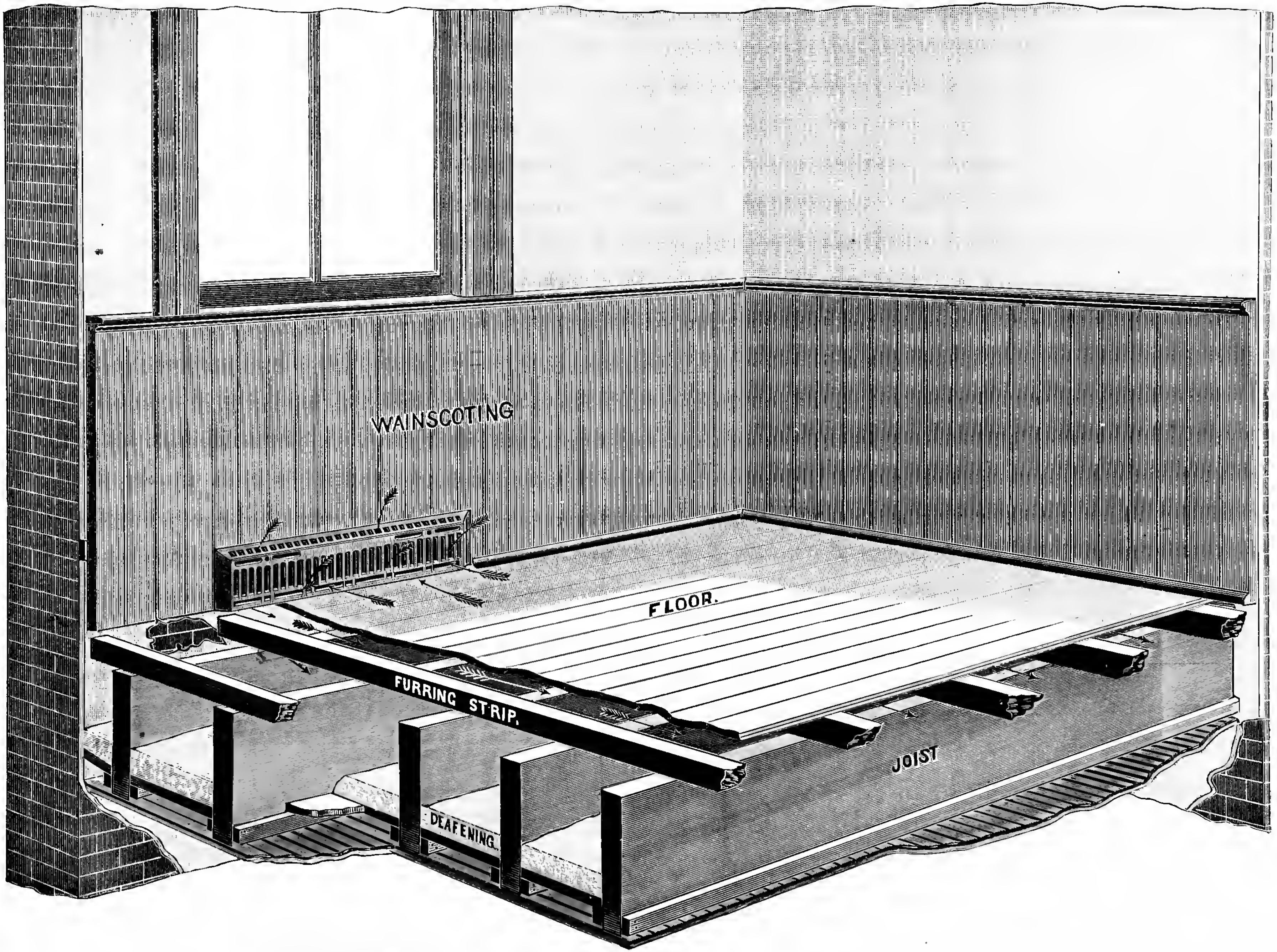
BASEMENT PLAN SEGUR AVENUE SCHOOL BUILDING, TOLEDO.



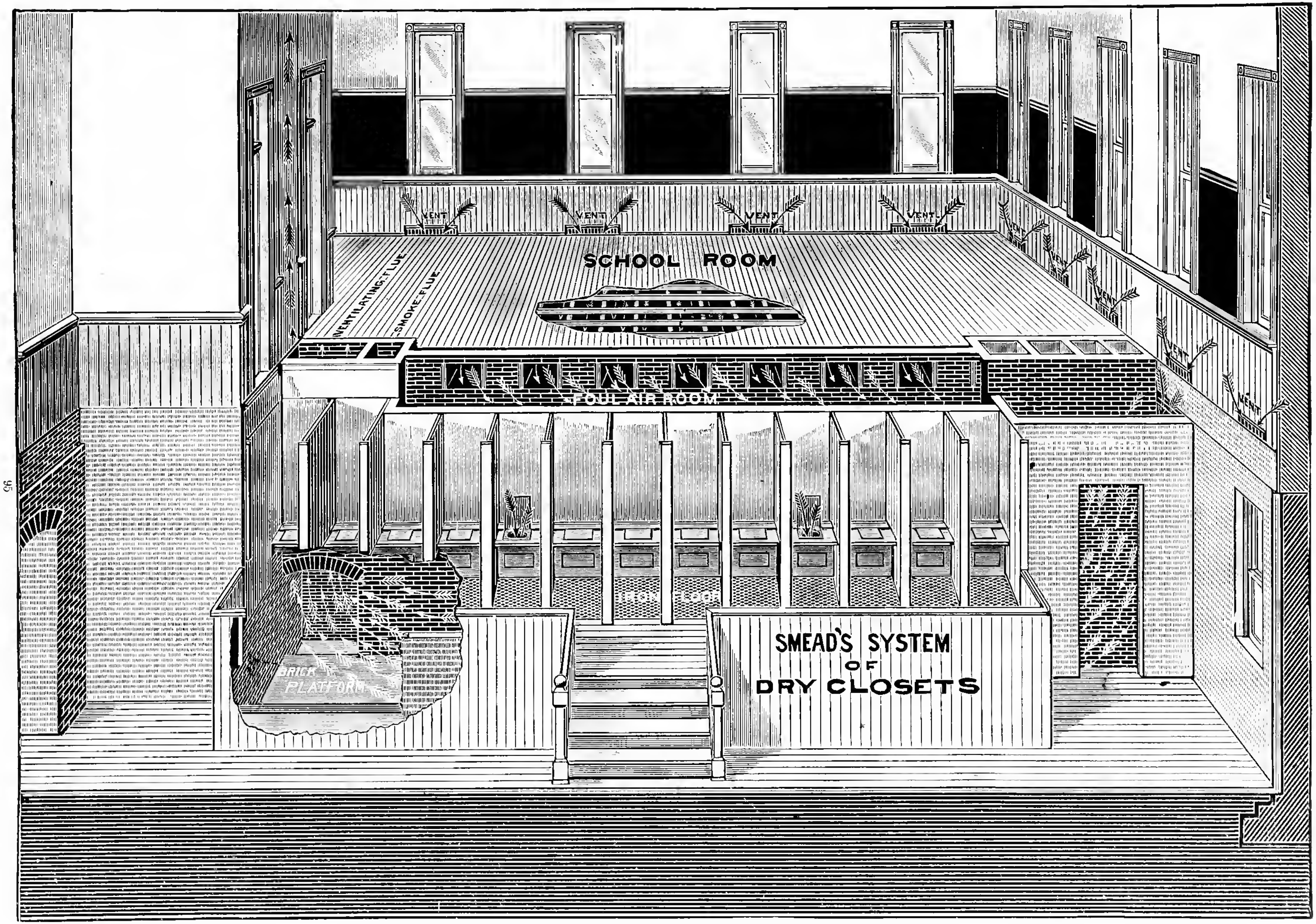
FIRST FLOOR PLAN SEGUR AVENUE SCHOOL BUILDING, TOLEDO.



SECOND STORY PLAN SEGUR AVENUE SCHOOL BUILDING, TOLEDO.



VIEW REPRESENTING THE SMEAD SYSTEM OF FLOOR CONSTRUCTION.



PERSPECTIVE VIEW OF CLOSETS AND ONE SCHOOLROOM, SEGUR AVENUE SCHOOL BUILDING, TOLEDO, OHIO.

Mr. Smead: Please give me further results of the Segur School building inspection.

Dr. ——— : The volume of air entering each of four rooms that ventilated into one common stack was between 67,000 and 78,000 cubic feet each hour. This was determined by an air meter accurately gauged. (See plan of Segur building on page 91.)

Mr. Smead: Then, if that volume of air entered the room, there must have been a corresponding outflow.

Dr. ——— : This was also determined. I went to the top of the ventilating shaft (in communication with these four rooms alone) and measured the volume of air escaping per hour. I found it to be about 300,000 cubic feet.*

Mr. Smead: How does that agree with your measured inflow?

Dr. ——— : Remarkably well. The measured inflow at the four registers in the rooms was 291,420 cubic feet per hour; the outflow at the mouth of the stack was about 300,000 cubic feet per hour.

Mr. Smead: Is the current constant, doctor?

Dr. ——— : I have never remarked any noticeable variation where the fires are uniform.

Mr. Smead: According to your estimates at this inspection, what is the supply of air for each pupil in the rooms?

Dr. ——— : The seating capacity of the four rooms is about 160; 300,000 cubic feet per hour would allow nearly 2,000 cubic feet to each of the 160 present.

Mr. Smead: What do you consider a fair allowance?

Dr. ——— : Under ordinary circumstances, 1,500 to 1,800 cubic feet *per capita* is an ample allowance.

Mr. Smead: The dimensions of each of these rooms are 26x36x12, making 11,232 cubic feet contents. The air in the rooms would be completely changed every ten minutes. That is not a bad showing.

Dr. ——— : I was somewhat astonished myself, and regard it as one of the grandest achievements of modern sanitary science. How do you produce such a uniform temperature? Actual trial at floor, ceiling and on two sides of the room showed a remarkable uniformity. There was not over two degrees F. variation from 73°.

Mr. Smead: The air enters in large volume, and rarely above 120° F. Of course it is possible to heat the air much hotter, but there is no necessity for a janitor allowing it to get above 120° F. Remember that an ordinary stove heats the air near it to 200° F. The gentle to-and-fro currents dissipate evenly over the whole room, and there is a gradual settling of the upper strata of air, the lower strata passing out at the outlets in the base-board, and *thence under the floor* on the way to the main exit shaft. This has been proven by the smoke-test. A room was filled with a dense smoke, and then the currents were established. The strata next the floor passed out first—warm air from the register taking its place above. This continued until the forms of those witnessing the trial emerged from the smoke level, as the trees rise above the fading mists of the valley, and then the desks, until finally the last vestige had passed out at the outlets in the base-board—this change of air taking just twenty minutes.

In the rooms that you have inspected, the foul air passes directly into the exhaust-shaft, for there is no "dry closet" in connection with this ventilating shaft. Did you inspect the other rooms in this building that are in connection with the dry closet?

Dr. ——— : Yes, sir; and I can give you some interesting figures from that investigation as well. The temperatures ranged between 69° F. and 74 (school was just out and some windows were opened where the janitor was sweeping). I then went down into the basement and entered the "foul-air-gathering chamber," on the boys' side. The air from four rooms passes into this chamber and thence over the vault contents. The temperature here was about 70° F. The platform receiving the ordure is about 30 feet long, and is somewhat elevated; the current of air passing above and below it.

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* This estimate is a little too high, since a portion of the outlet at the top of the stack was necessarily blocked by the body of the person holding the air meter, and hence the velocity was increased; but no deduction was made.

Mr. Smead : What volume of air did you find passing at this point. i. e., through the dry closet ?

Dr. ——— : On the boys' side, I measured the volume of air passing each hour as 338,250 cubic feet. On the girls' side of the building, the result was 381,300 cubic feet each hour.

Mr. Smead : That makes a velocity of over seven miles an hour ; quite breezy for a closet vault.*

Dr. ——— : There are few cities whose streets are as thoroughly disinfected by purifying winds as are the closet vaults with your system. Your comparison of the contents of such vaults with the "buffalo chips" of the plains is a very appropriate one.

Mr. Smead : Yes, and I have often wished that I could imitate Nature still further by getting a little direct sunlight into those vaults. Have you ever examined carefully the contents of a vault ? It is only by such close inspection that the skeptical can be convinced of the state of "innocuous desuetude" to which human ordure can be reduced. Describe more minutely this drying process.

Dr. ——— : Human ordure is mixed with more or less mucus from the bowels. In health this is only moderate in quantity, but there is sufficient to form a thin pellicle around the drying mass. This drying progresses until there is only a porous, parched mass left, retaining the original form and very tough and firm in structure.

Mr. Smead : Now that reminds me, doctor, that I was accused not long ago of being instrumental in the infection of whole communities. One would think that I had invented a *disease-germ factory ;* and the imprecations of the gods were invoked to punish me. Such accusations, couched in terms of ominous scientific meaning, worried me ; but I soon made up my mind to fight it out, for a great fear of death came over me then. How could I face the multitudes whose death I had caused ? My friends were all among the living. I worried some, investigated a great deal, and finally I simply made up my mind *to go on making more friends* in this world, and let the "disease-germ" scare die a natural death.

Dr. ——— : A little knowledge, in a head that has ample natural ventilating capacity, can stir up quite a commotion, especially on such a vital question as that pertaining to health and disease; but the question has at last found a natural resting-place, as far as your dry closets are concerned, has it not ?

Mr. Smead : I think so, but should like a little testimony from you on this point. What "disease germs"—admitting that they do exist—can be feared by the most skeptical ?

Dr. ——— : That of *typhoid fever* is the only one that can be feared in connection with dry closets. There cannot be much danger from this disease, since the specific germ probably does not appear in the excreta until the disease is quite well established. Typhoid fever is most common between the ages of fifteen and twenty-five. There are few children attending the public schools more than nineteen years of age. Hence it is quite rare that a child sick of typhoid fever would be found in school, and still more rarely would the disease be so far advanced that the specific germ would have made its appearance in the stools. And, even admitting that the *bacillus typhosus* may find its way into the vault, I don't see how it could get into the atmosphere.

Mr. Smead : It seems to me the germs would be retained in the dry mass. I never advise that the contents of the vaults be stirred up. Surely nothing of an infectious nature can survive the burning to which I recommend that the vault contents be subjected at convenient intervals. Is it possible for these minute disease germs to grow and multiply in a dry closet ?

Dr. ——— : They are as uncomfortable there as a fish out of water. Cholera bacillus is absolutely destroyed by a few hours of drying, according to many experiments carried on in Koch's laboratory, Berlin, and as far as typhoid bacillus is concerned. only the spores could possibly survive the drying. Moisture is all-essential to the welfare of bacteria of disease and of decomposition, and that is the reason why they love the methods of the plumber, but wither up and die under the enormous flow of oxygen that hourly passes through your dry closets.

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* Compare this with the amount escaping at the exhaust-shaft not operating in connection with "dry closets"—having no foul-air-gathering chamber—the air from rooms passing directly into the shaft at its own floor level.

Mr. Smead : But to come back to the inspection. What volume of air did you find passing through each of the dry closet vaults ?

Dr. ——— : About 350,000 cubic feet per hour is the average through each vault.

Mr. Smead : This is equivalent to 2,735 cords per hour ; how much moisture is that capable of taking up ?

Dr. ——— : If it leaves the rooms at 80 per cent relative humidity, it is capable of taking up about 5 gallons of water an hour, or about 120 gallons for twenty-four hours ; 60 gallons for twelve hours.

Mr. Smead : What would be the amount of daily watery excreta for about 360 pupils ?

Dr. ——— : About 9,000 ounces of water is a liberal estimate.*

Mr. Smead : There are 128 ounces in a gallon, and hence 5 gallons per hour is equivalent to 640 ounces an hour. We should multiply this by two to find the total amount of evaporation going on in both boys' and girls' closets, giving 1,280 ounces an hour. Now the number of hours during which the air is passing at the rate of 350,000 cubic feet varies. Here in Toledo it passes nearly twenty-four hours, because we have natural gas ; but ten hours is a fair estimate for most other places. This, then, gives us an evaporating capacity of nearly 13,000 ounces of water each day, while the maximum *estimated* daily excretion of water is about 9,000 ounces.

Dr. ——— : The basis of computation is certainly very fair.

Mr. Smead : Well, you know I like *fact figures* better than *theoretical figures* anyway, and since *fact figures* are obtainable let us compare the *theoretical figures* with them. I agree with you that your estimates seem very fair, judged from a common-sense point of view, but let us look at the facts. I recently estimated (by weighing a portion) the dried residue in one of those closets. I found about 56 pounds in each closet, making less than 120 pounds of dried residue in both. This has accumulated in about 120 days, making less than 1 pound dried residue per day from 360 pupils, while, according to your estimate, there should be something over 10 pounds a day of dried deposit.

Dr. ——— : My figures are outside estimates—a mixed population of a city averages about 2½ ounces per day excreta. I assumed 2 ounces for school children—rather high. Hence you see that my estimates on the capacity of evaporation are also outside and safe figures, the premises being granted.

Mr. Smead : Right here, doctor, I should like to read you an extract from Sewall's article on "The Physiology of Respiration":

THE PHYSIOLOGY OF RESPIRATION.

It is said that we breathe to purify the blood. But how? Why is it, then, when we wish to preserve, to keep pure, any organized matter, as vegetables or meat, we remove, as far as possible, all air, and secure it from its action? If the air will purify the blood, why not meat, or any other organized body? Now we know that the air—or the positive acting agent, the oxygen—always acts as a destroyer ; its sole office is to tear down, to break up all organic compounds and resolve their elements into simple and more stable groups. Its office and tendency is everywhere the same, and unless this tendency be resisted by some antagonizing force the oxygen would speedily and completely destroy the whole organized world. Then why does not oxygen destroy the animal? It does, and yet does not. It feeds upon the very tissues of the body, and is fed by them ; it demands victims to be sacrificed to appease its never-satiated appetite ; and were it not for that strange and mighty force which we name and recognize, but do not comprehend—vitality—which regulates and controls the action of this agent, it would speedily resolve all organized matter into stable and lifeless forms. Literally, the organized world would be burned up and naught left but its ashes ; and when vitality ceases to antagonize or resist its action we return to the dust from which we sprung.

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* Each pupil is assumed to pass about 25 ounces of watery excreta daily, and 2 ounces of solid. This gives about 9,000 ounces of water daily, for 360 pupils, to be evaporated. One cubic foot of air at 65° F. and 81 per cent relative humidity is capable of taking up .312 grains of watery vapor before it is saturated (the air rarely reaches 81 per cent relative humidity in rooms, and is often above 70° in vaults). The exposure is not complete, and so it is assumed in the above that 1 grain (instead of 1.32) is taken up by each cubic foot of air passing through the vaults. 350,000 cubic feet pass through, and hence 350,000 grains of water are taken up each hour, or 700,000 on both boys' and girls' sides of building, equal to 10 gallons. Solid excreta, 2 ounces per day per capita, gives 720 ounces per day, less 75 per cent for water, equals 180 ounces per day, being more than 10 pounds per day dried residue.

Then, breathing is not for the purpose of purifying the blood, but to break down the tissues of the body and remove them under the direction and control of the vital principle. In all animal tissues there is a work performed which has a tendency to wear out and render unfit for service parts of themselves—parts or molecules that have lost their vitality—and these worn-out molecules become the food for oxygen. These worn-out atoms are, for the most part, hydrogen and carbon. The oxygen seizes upon them and converts them, by thus uniting with them, into carbonic acid and water, or, using another figure, the oxygen may be regarded as scavenger boats, which enter the lungs, pass into the blood, and are carried into every part of the body, where they are loaded with these worn-out elements, carbon and hydrogen. With these loads they return through the veins to the lungs and pass out into the air in the form of carbonic acid and vapor of water. They are now taken up by the leaves of the trees, unloaded, the carbon and hydrogen entering into and becoming a part of the tree, while the unloaded scavenger boats (oxygen) are returned to the atmosphere to repeat the process. Verily, then, the "leaves are for the healing of the nations." This, then, is the office of respiration—*to remove the worn-out tissues of the body.*

Now if the air is more or less saturated with this carbonic acid, some of these loaded barges, when we inhale a breath of air, will enter too. The demand of the tissues is for vehicles to carry away the waste products, and the demand is imperative; and though the loaded barges go at the call of the suffering tissues, they cannot remove any of the material, for they are already completely loaded. Two atoms of oxygen can take but one of carbon, and therefore they but obstruct and block up the way, and thus produce disorder and disturbance—disease.

Now there must always be a small amount of carbonic acid in the atmosphere, because it is continually being emitted by the whole animal kingdom, and as a product of combustion and decay. Yet, by the peculiar law of gaseous diffusions, it is so completely diffused through or mingled with the atmosphere that it amounts to only $\frac{1}{2500}$ of its weight.

As the specific gravity of carbonic acid is considerably greater than that of the air, were it not for this gaseous diffusion it would settle to the bottom of the atmospheric ocean and form a layer five feet in depth.

But if only the normal amount be present, it is completely diffused, so that we find it existing in exactly the same proportion on the mountain and in the valley. But if more than $\frac{1}{2500}$ be present, the tendency is to settle at the bottom, making the ten per cent of carbonic acid greater near the surface than in the higher regions. Thus in the *Grotto del Cane*, in Italy, where the gas escapes in large quantities from the earth, all animals entering the cave almost instantly die from the effect of breathing the carbonic acid. Now, if the air contain only one or two per cent, its effect is clearly poisonous. If ten per cent, it produces immediate death.

Mr. Smead: That is a beautiful explanation of the part that oxygen plays, and it seems to me that there is an *actual destruction of dried fæcal matter* constantly going on and passing off in combination with oxygen. This may account for the very small amount of residuum found in the vaults as compared with your estimates. These features are interesting, but let us refer back to the schoolrooms and their relation to disease propagation. Why do childhood diseases spread so rapidly?

Dr. ———: Because as a rule school children breathe and re-breathe the same air. The natural vitality and resisting power of the system is thereby lowered, and the element of contagion is free to gain access to the system, and the work of disease begins.

Mr. Smead: Surely then good ventilation in schoolrooms and pure, wholesome air will lessen spreading of contagious diseases.

Dr. ———: You are quite right in your inference and statistics will prove the same. Brown-Sequard reports that he has found and isolated a poisonous ptomaine (an organic constituent) in the air from the lungs, and that its poisonous effects are intensified by raising the temperature. This may account for the rapid spreading of childhood diseases to a large extent, for in the diseased state such poisonous excreta are certainly increased. Heating by direct radiation (as by stove or steam-coil in the room) would then have the effect of heating up the poisonous constituents of the breathed air, and thus intensify their virulency. This method of heating would not even dilute these poisons, but they continue to accumulate, and are not only re-breathed but are deposited on walls and ceiling, and, together with watery vapor and organic matter, furnish a most excellent feeding-ground for disease germs to grow and multiply.

Mr. Smead: Doctor, what becomes of the "foul air," laden with human emanations and gases resulting from the destruction of the vault contents, after it escapes from the top of the ventilating stacks that I erect?

Dr. ———: I have frequently taken the temperature at the stack outlet, and have always found it more than 10° F. above that of the surrounding air. Now the rate of ascent of the air in the ventilating shaft depends on the difference in temperature between the air in the shaft (it is better to take the average of the *whole system* from the furnace to the shaft outlet) and that of the atmosphere outside. Hence, if we have 10° F. *difference* at the outlet, the average for the whole system would be much higher, and (disregarding friction) *this difference of temperature is an index of the velocity of outgoing current.*

Mr. Smead: If you found the air of the shaft outlet 10° F. higher than the outside air, the average for the whole system would give at least 20° difference. You say at one interview that the air in the vault was 70°; in other words, the base of the stack is 70°, and the average temperature for the twelve school months is 43° F. There you have a difference of 27° F. This gave a current of about seven miles per hour at the shaft outlet.

Doctor ———: The air leaves the mouth of the foul-air shaft at a velocity between five and seven miles an hour.

Mr. Smead: On a still day that would certainly continue its ascent, just as we often see the smoke from a factory chimney rise to thirty-five or forty feet above the outlet. But I am aware that smoke is not a gas, and does not diffuse rapidly.

Dr. ———: The gases of which the foul air is made up mingle very rapidly with the pure air. The degree of dilution is, under the most simple calculation, the square of the distance from the shaft outlet. Let us take a pailful of air containing about one part of carbonic acid to one thousand parts of air (and other gases in proportion) and follow the rate of dilution. At 100 feet from the shaft it would be about *one part of the foul gas to* 10,000,000 *parts of air.* Remember that the oxygen destroys these noxious gases very rapidly, and the sunlight purifies by the chemical properties of its rays; and when you consider the *small space* occupied by people as compared with *all space* you could then multiply by one hundred millions more, and not then reach the limit of diffusion that takes place after the foul air from school buildings leaves the ventilating shaft.

Mr. Smead: What an overwhelming dose of poisonous air the neighbor to the school-house must endure! If he can muster the audacity to assert that this air is injurious in such a state of dilution, he would do well to carry his delusion into commercial life by squeezing a lemon in the Maumee river, and selling Lake Erie by the glass as lemonade!

THE DRY CLOSET SYSTEM OF DISPOSING OF EXCREMENT.

BY JOSEPH A. STILWELL, M. D., BROWNSTOWN, IND.

From Indiana State Board of Health Report.

This is worked on the same principle as that by which mines and tunnels are ventilated.

The thing of primal necessity is a shaft or chimney that will conduct a column of air so high above us that its output will be beyond our breath supply.

This is necessary in order not only that the foul air may be placed beyond our reach but that it may be thrown out into a wide range of atmosphere, where the great law of the diffusion of gases will scatter and mix it in such a manner that its noxious properties are destroyed.

In mine ventilation the shaft is sunk into the earth until it reaches the mine at a place farthest from the shaft by which the mine is being worked. Then heat is made by fire at the bottom, which lifts the air to the top of the shaft above ground, and by the vacuum thus created fresh, pure air is invited down the work-shaft and carried through the mine to the ventilating shaft. A circulation of pure air is in this way supplied to the miners and the foul air carried off.

The dry closet is made at the bottom of a stack, shaft or chimney and heat applied at this point. The heat raises the air and carries with it the foul volatile matter of the excreta. Volatilization and evaporation are continued until only the dry residue is all that remains.

To accomplish this a shaft or chimney with a stove at the bottom, or a lamp may do all that is needed, with privy seats so arranged that a current of air will be conducted from the outside, under them, or through the holes, to supply the rarified space about the heated stove. So long as the heat is kept up this current and vaporization will continue, and the drying and neutralization will take place.

Testimony that will establish the practical application can be furnished, of which the following is prominent:

Dr. T. Clark Miller, of Massillon, Ohio, then president of the State Board of Health of that State, has taken pains to examine and report on the efficiency of this system; he says:

> It is almost a new sun in the sanitary heavens.

He had the firm of Isaac D. Smead & Co., who are putting in apparatus of this kind, employ Prof. Kirchmaier, of the Northwestern Ohio Medical College, to examine and make a report of the working of the closets of this firm.

THE OHIO STATE BOARD OF HEALTH.
MASSILLON, Ohio, March 22, 1887.

ISAAC D. SMEAD, ESQ.:

Dear Sir,—Have you the data to fill a table, such as the one enclosed, as to the schools warmed and ventilated by your system in Toledo? Of course the percentage of CO_2 is the crucial test. I would like to have these points for use in a report on Warming and Ventilation and School Hygiene, which I am gathering information for, and intend to prepare during the present year. Of course if I cannot get these points I will have to do without. I thought it possible you might have them. Yours very truly,

T. CLARKE MILLER.

Isaac D. Smead & Co., Toledo, Ohio:

Gentlemen,—Your order to make quantitative analysis and other experiments to ascertain the salubrity of the air in a school building containing your warming apparatus and ventilating system, as requested by Dr. T. Clarke Miller, President of the State Board of Health of Ohio, has been complied with.

On April 5 we proceeded to the Illinois Street School building, which is warmed and ventilated by the Smead apparatus and contains the Smead system of dry closets in the basement.

The closets we found in perfect condition; the air in the rooms in which the closets are situated was entirely free from the objectionable odors usually found in such places.

The following is a tabulated, analytical report of the air in and about the Illinois Street School building:

Eight estimations were made—four for carbonic acid gas and four for oxygen. Air was collected at different heights in the rooms, during school hours, on April 5, P. M., and April 6, A. M.

For estimating carbonic acid gas, Pettenhofer's method was used.

For oxygen, Liebig's method.

In rooms grade 1, 2 and 5, we made such experiments as we thought necessary, with results as shown in the annexed table.

All of which we respectfully submit.

(Signed) G. A. Kirchmaier, Ph. C.,
Prof. Chemistry and Toxicology,
N.-W. Ohio Med. College.

1	2	5	Grade of room.
60	60	60	Number of seats.
66	40	48	Number of persons present.
Between 3 and 4 P. M. and between 10 and 11 A. M.			Hour of visit.
2.981	2.981	2.981	CO_2 in 10,000 parts in outside air.
4.450	4.261	3.990	CO_2 in 10,000 parts in rooms.
21.001	21.001	21.001	Oxygen in outside air in 100 parts.
20.796	20.820	20.812	Oxygen in air in rooms in 100 parts.
.85	.85	.85	Relative humidity in outside air.
.79	.83	.74	Relative humidity in schoolrooms.
42°	42°	42°	Temperature outside.
70°	68°	70°	Temperature in rooms at floor.
70°	68°	72°	Temperature in rooms 4 feet above floor.
72°	68.5°	72.5°	Temperature in rooms at ceiling.
1	1	1	Number doors—closed.
7	7	7	Number windows—closed.
7	7	7	Number ventilating registers—open.
11,000	11,000	11,000	Cubic feet in rooms.
8.9	8.3	10.8	Time required to change air in rooms, in minutes.
6½	8½	11	Average age of children.

Dr. Van Pelt, Health Officer of Toledo, Ohio, also reports :

I regard the Isaac D. Smead system of dry closets healthful in every way.

Mr. P. D. Bricker, of Jersey Shore, Pa., says :

The dry closets are efficacious, novel and highly appreciated by us, as they work well.

A special committee of the Board of Education of Englewood, Ill., August 5, 1886, reports :

We inspected the building (a school building in Toledo, Ohio) very thoroughly. Each vault was about 24x3 feet and 20 feet long. These are connected with a ventilating shaft, which is 4x5 and 69 feet high. In the base of the shaft was an iron furnace with a very moderate fire in it. Nothing had been removed from either vault since they were erected one year ago. *The door at the end of the girls' vault was wide open, and closet connected directly with the janitor's living-rooms, all the doors being wide open.* In approaching this vault, and even in standing within the vault door, *there was not even a suggestion of disagreeable odor.* We were astonished at the small amount of excrement left after a year's use by 800 children, showing that almost all of it goes up the flue as vapor.

We tested the draft through the privy vaults with an anemometer, and the result showed a passing 1,250 cubic feet per minute in each. It must be remembered that the mercury on the outside of the building stood at 85° and 90°. We burned some of the dry excrement in a furnace fire, and it burned as readily as cannel coal.

In the same report of another building this committee says :

Five hundred children have been in attendance at this school, and no excrement has been removed for two years. We went into this vault and found no disagreeable odor whatever. There was no fire in the ventilating shaft, but the current of air from the closets was very strong. In the boys' closet some holes had been bored through the floor into the vaults for the accommodation of urine accidentally spilled. Tested with a match there was found to be a strong current of air down through the auger-holes. The vaults could be easily cleaned by one man in two hours, and the system works perfectly, and the entire cost was less than $150.

Dr. G. W. Keely, a member of the school board of Oxford, Ohio, after reciting the encomiums of various parties whom he came in contact with on a tour of inspection of school apparatus, says :

At the South Street School building, Toledo, we saw the best test of the dry closet system. This is an eight-room building. The superintendent and janitor told me that at least four hundred pupils had been using these closets for two school years, and that the vault had never been cleaned. I examined the vault carefully, crawling by the side of at least three stalagmites made by deposits from the boys, striking them with my cane. They were hard and dry, and it seemed to me that a bushel basket would hold all the vault contained. When necessary to clean the vault the deposits can be burned.

D. W. Jefferis, of Chester, Pa., in a paper read before the State Sanitary Convention at Philadelphia, says :

Somebody has said that he could judge of the civilization of a people by the condition of their privies. Between the foul-air-gathering rooms and the ventilating shaft we have placed our closets. Through each set of closets will rush 150,000 cubic feet of dry, warm air every hour. This air has already accomplished the two-fold purpose of warming and ventilating the rooms above, and now is called to another office as it sweeps up the big chimney, carrying with it all the moisture and bad odor of the excreta, leaving behind only a small quantity of inodorous material, which burns readily, and which may be actually burned *in situs* or thrown into the furnace. No malodor can possibly reach the schoolroom.

The apparatus necessary to the most economical and efficient application of the system is as yet limited to that of Isaac D. Smead & Co., Toledo, Ohio, and associated offices, so far as I am able to find, and to whom I am indebted for the references to prove their effectiveness, and of course whose acts in the premises have to be taken with the much swallowed *cum grano salis.* But they forestall objections by guaranteeing satisfaction.

But *per contra* what have we? The privy vaults and cesspools are the same authorized by Moses, and have not been improved since the Children of Israel crossed Jordan to the Promised Land after the exodus. And without any intent of disparaging the sanitary regulations of the translated lawgiver, we must say, after four thousand years of experience, that they are methods of hiding a poison, filling the earth with traps and snares to destroy those who follow us; that the germs of pestilence and death thus planted and cultured, carrying yearly victims to untimely graves, is the reproach of the system, and mankind cries aloud to be spared.

The sewer, while it has a fair appearance in many respects, is only passing the evil to the next neighbor, with the compromise that it shall continue to pass, but finally is stranded on the first shoal of river or bay, only to be compromised with again by some new contrivance and expensive outlay. London has two thousand miles of sewer, at an expense of one hundred and fifty millions of dollars, and her filth on hand yet. New York, only a short time since, had an estimate for repairs on her sewers amounting to six million dollars.

If you wish to puzzle a man of science who has given attention to the subject, you only need ask him what is to be done with future accumulations of effete matter.

The theory of dry closets is very simple. The practical application is simple and efficient. Instead of hiding away in pits and sinks—traps and snares for the unwary—or slushing miles of filth into rivers of pollution, and passing it from hand to hand, the giant is to be strangled in its cradle by the constant watchfulness of draft and evaporation.

When every house shall have a shaft to evaporate its filth; when the human brain shall set down to cheapen and render efficient this system, then sewer and vault will be the adjuncts of the drying process.

Permit me to imagine a large city, having every habitated point set with a drying shaft; having the accumulating filth continually on the move upward, and by this means constantly creating space to gather in pure air from the hills and valleys, rivers, lakes and seas; from where contamination has been spared in the same way; imagine the new impulses, the growth of brawn and brain, the profits, the pleasures, giving all life a new lease and deeper leasehold, where aggregation means growth, instead, as now, decay and death.

If vital economy and health genesis is the purpose of these public boards—and that they are no one who observes their efforts will deny—then the questions and knowledge regarding them should be laid before the millions who are the inevitable partakers of their fruits, be they good or bad, in such a manner that they who are the final arbiters may see and feel the right, and select with intelligence and correctness.

Smead's Schoolroom Heater.

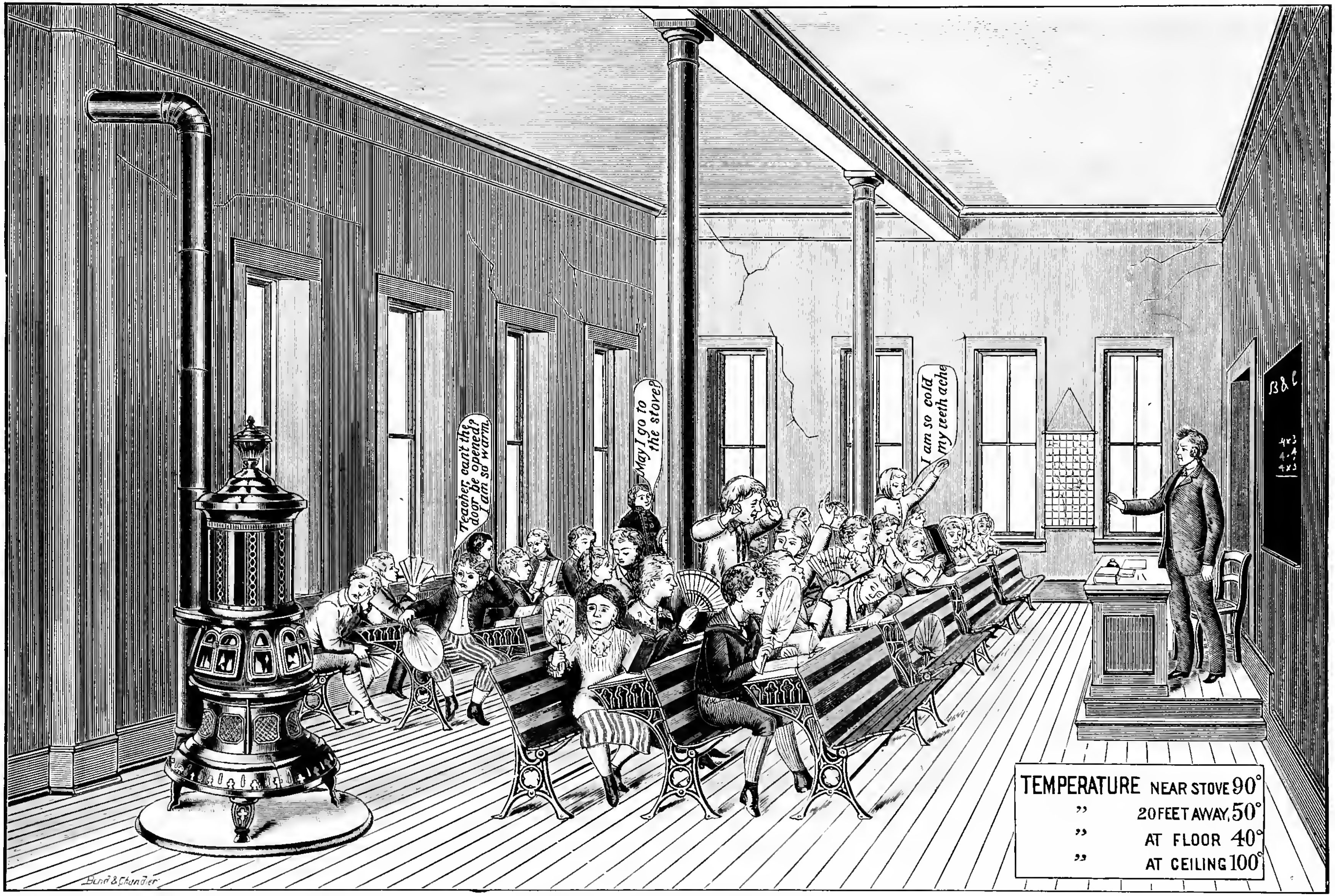
(See pages 106 to 112.)

THE cuts on pages 108 and 111 represent the Ventilating Heater we are now manufacturing for use in school or other buildings where a furnace cannot well be introduced. The favor with which our *Schoolroom Heater* has been received by school directors, church trustees, merchants and others, has induced us to expend a large sum in adding new features which, we think, will make it by far the most popular ventilating stove ever manufactured. The advantages of an OPEN FIRE OVER A CLOSED ONE, in the matter of *warming the feet* and conducting the foul gases from the room, are too apparent to require comment from us.

The first ventilating stove ever made was patented by Mr. Ruttan. For the past twenty years a great many of his stoves have been manufactured; but as they were only suitable for burning *wood*, we could not meet the demand for a *coal-burner*. We are aware that there are other ventilating stoves (so-called) in the West, and have examined them all with great care. We made the examination with the intention of buying the right to manufacture the one best suited to the work—that is, warming with a volume of air instead of by radiation. By our examination we learned that all schoolroom stoves were but little more than a common cannon stove with a sheet-iron case, and that the amount of air they would warm was by far too small to *properly* ventilate a schoolroom.

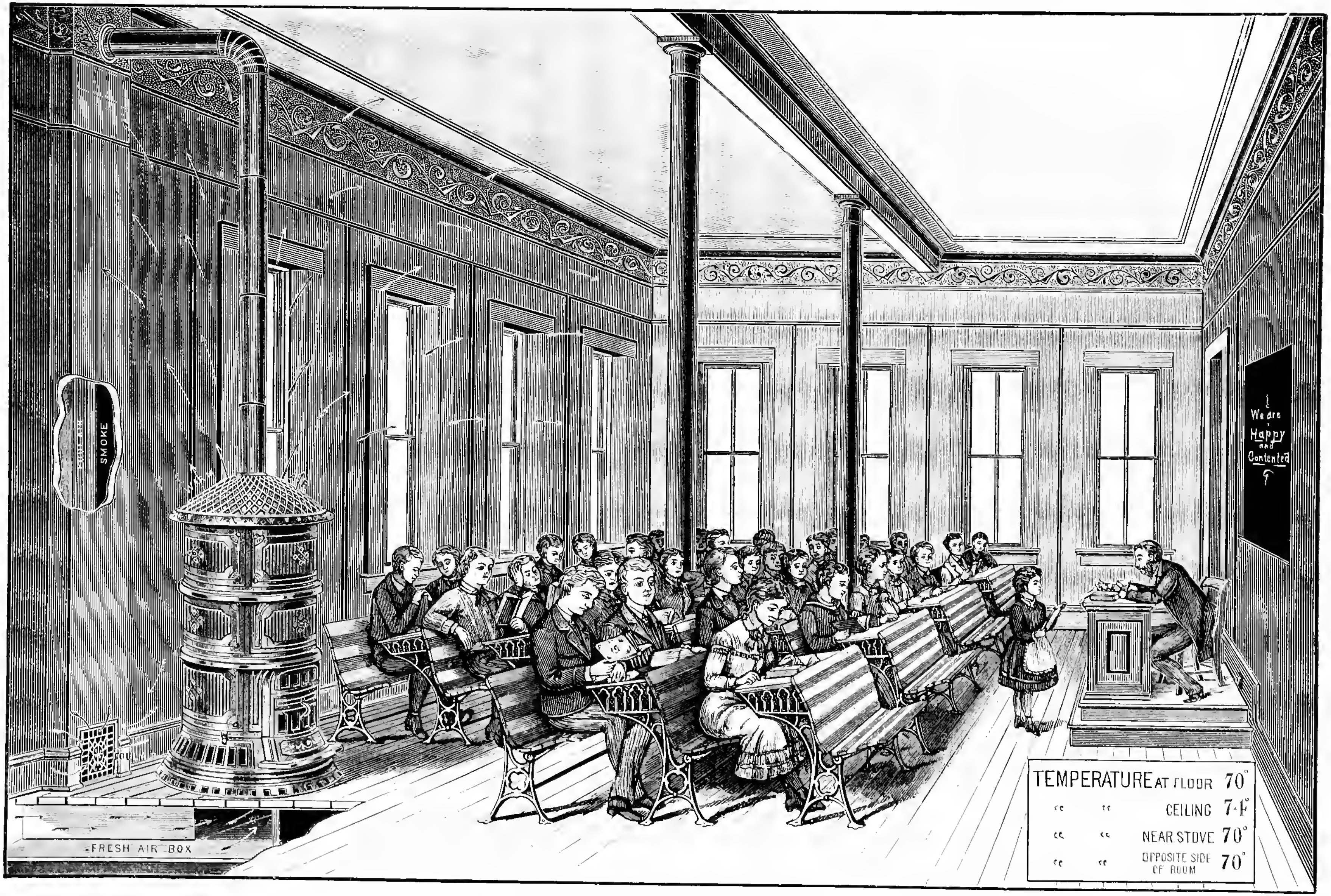
The principles upon which we have constructed our stove are substantially the same as we have heretofore used in our furnace, to-wit: a large amount of actual fire surface, large fire-box, and more than twice the grate surface of any other heater. The casing, being of cast-iron, radiates less heat, is more ornamental, and less liable to injury by *rust* or blows from pupils than if made of sheet-iron.

We guarantee the heater to burn soft coal or wood equally well, although it is made with especial reference to the consumption of soft coal. Its weight is about *four times as much as other stoves*, and great care has been used to make it *durable*.


Teacher can't the door be opened? I am so warm.
May I go to the stove?
I am so cold my teeth ache
TEMPERATURE NEAR STOVE 90°
" 20 FEET AWAY, 50°
" AT FLOOR 40°
" AT CEILING 100°
Bond & Chandler

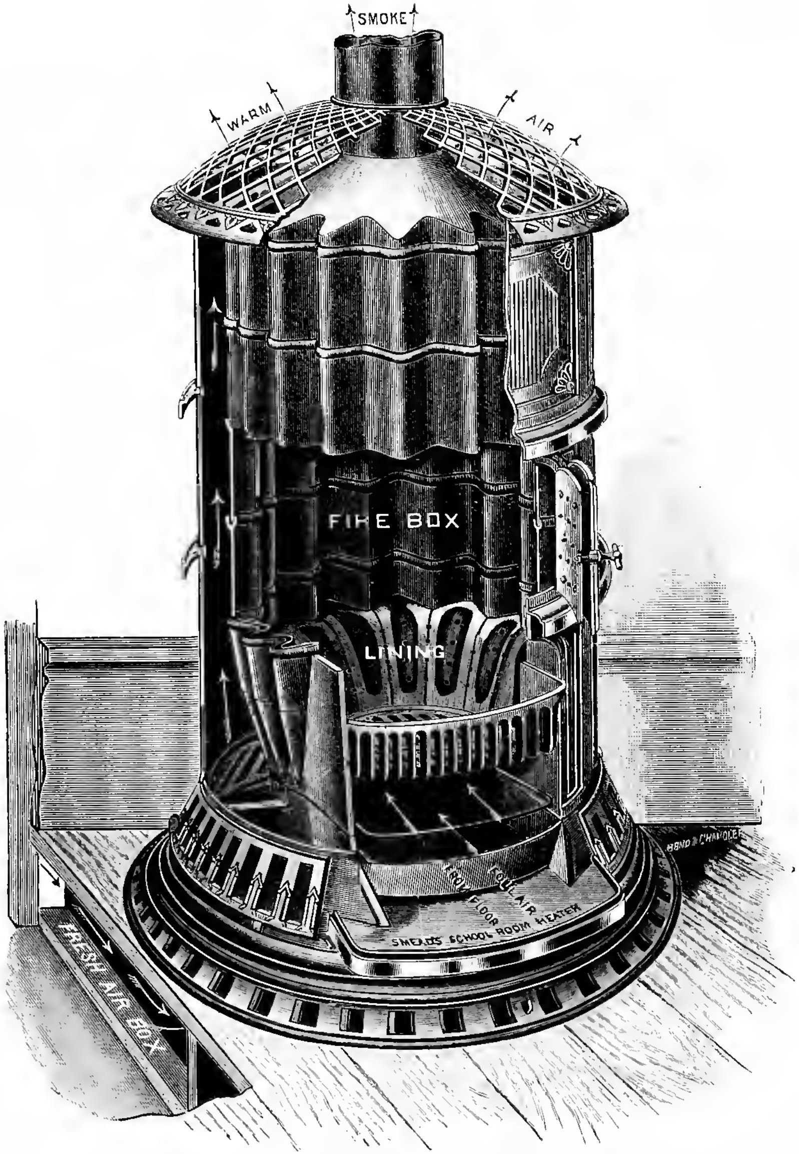
DIRECT RADIATION.

A possible condition of a Schoolroom warmed (in part) with a common radiating stove. If the pupils were permitted to "speak their mind," the above would very truly represent the scene.



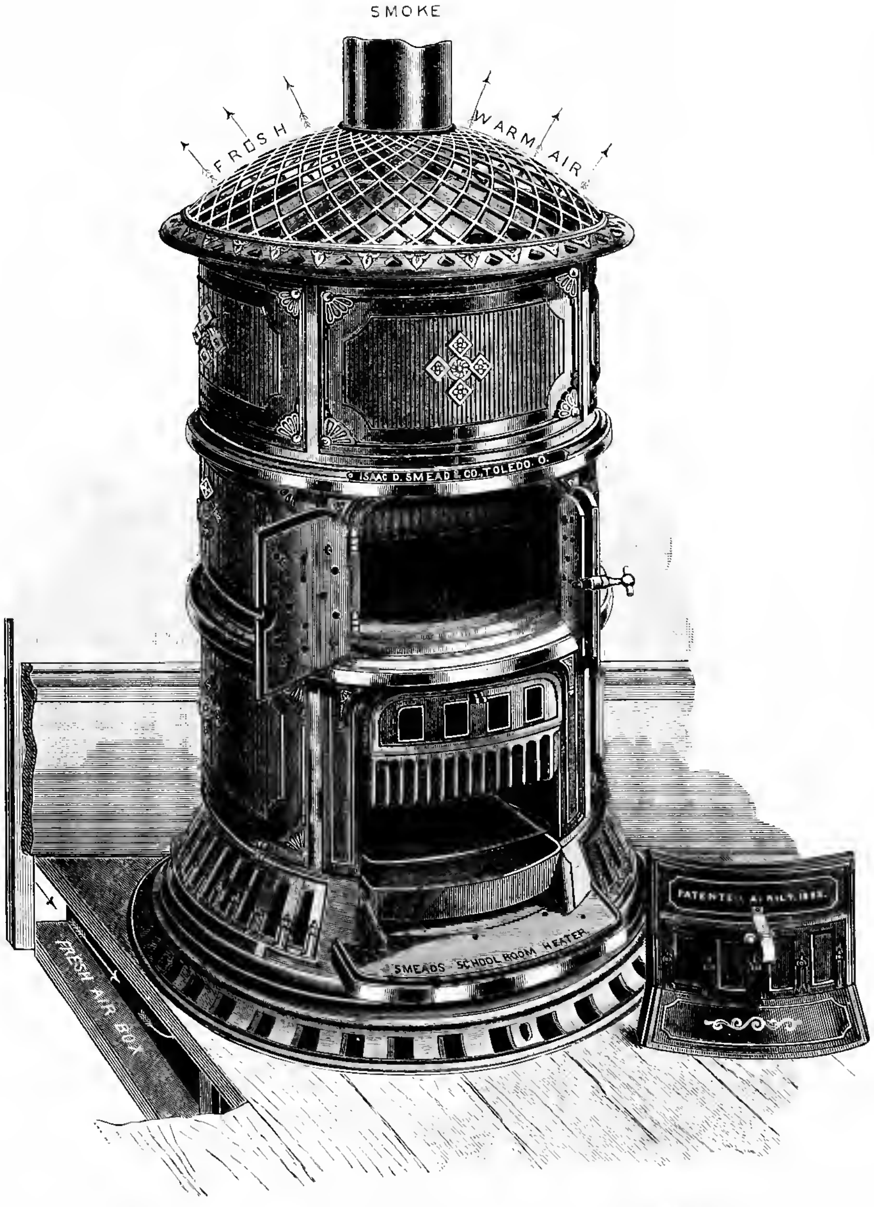
WARMING BY PURE AIR.

The condition of a Schoolroom with Smead's Schoolroom Heater.



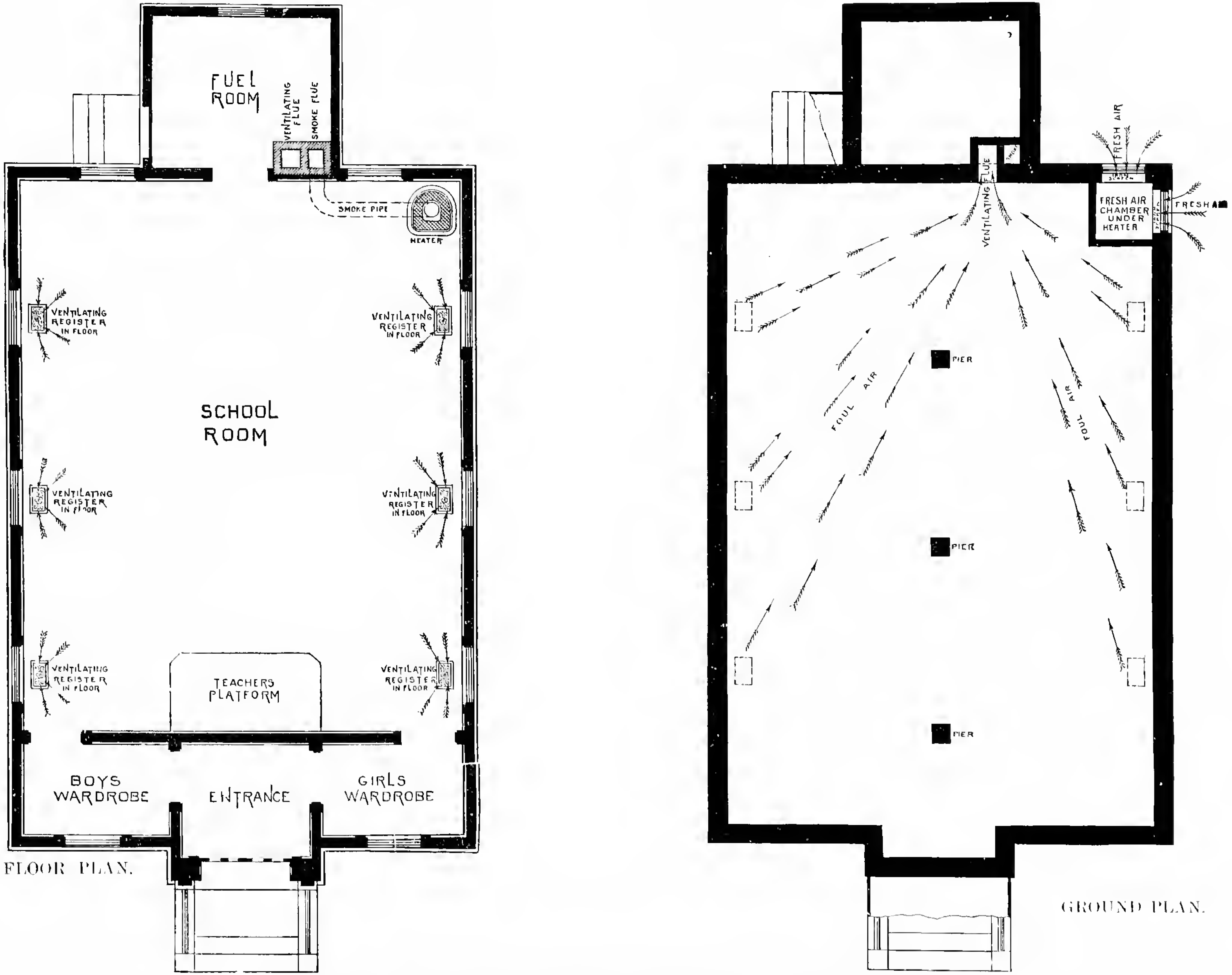
INTERIOR VIEW OF SMEAD'S SCHOOLROOM HEATER.

For description, see page 105.



EXTERIOR VIEW OF SMEAD'S SCHOOLROOM HEATER.

For description, see page 105.

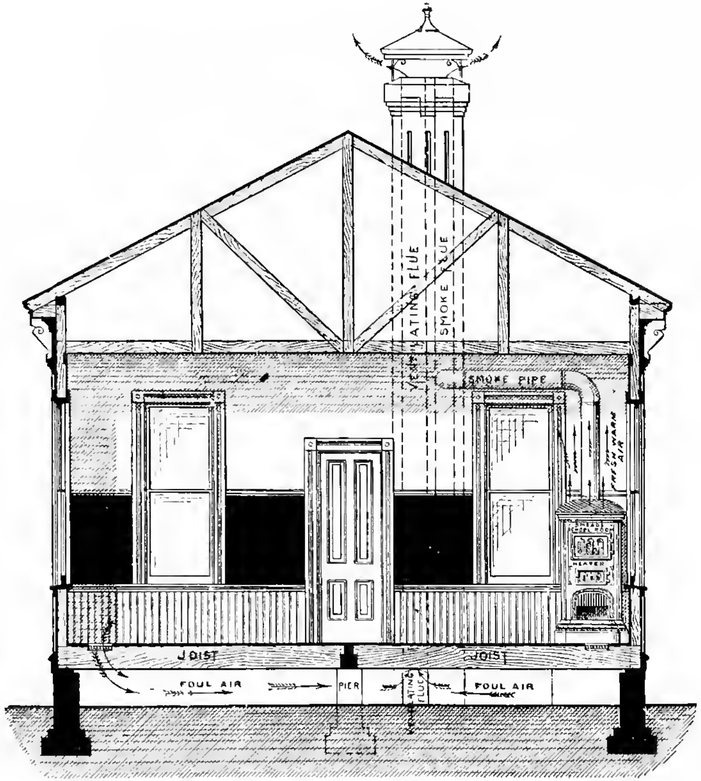


FLOOR PLAN.

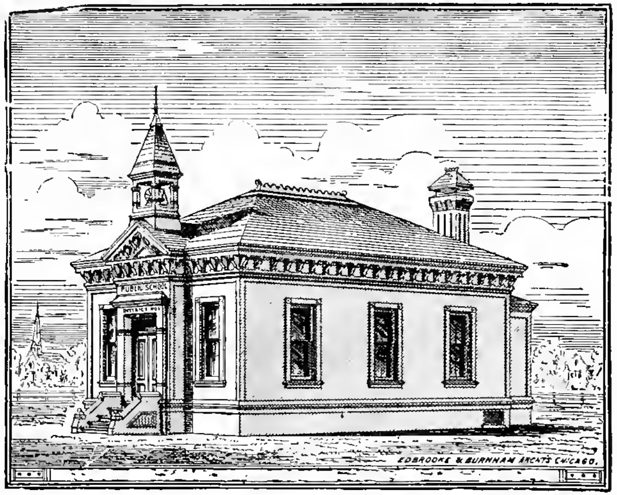
GROUND PLAN.

FLOOR AND GROUND PLANS OF THE MODEL DISTRICT SCHOOL.

(See page 110.)

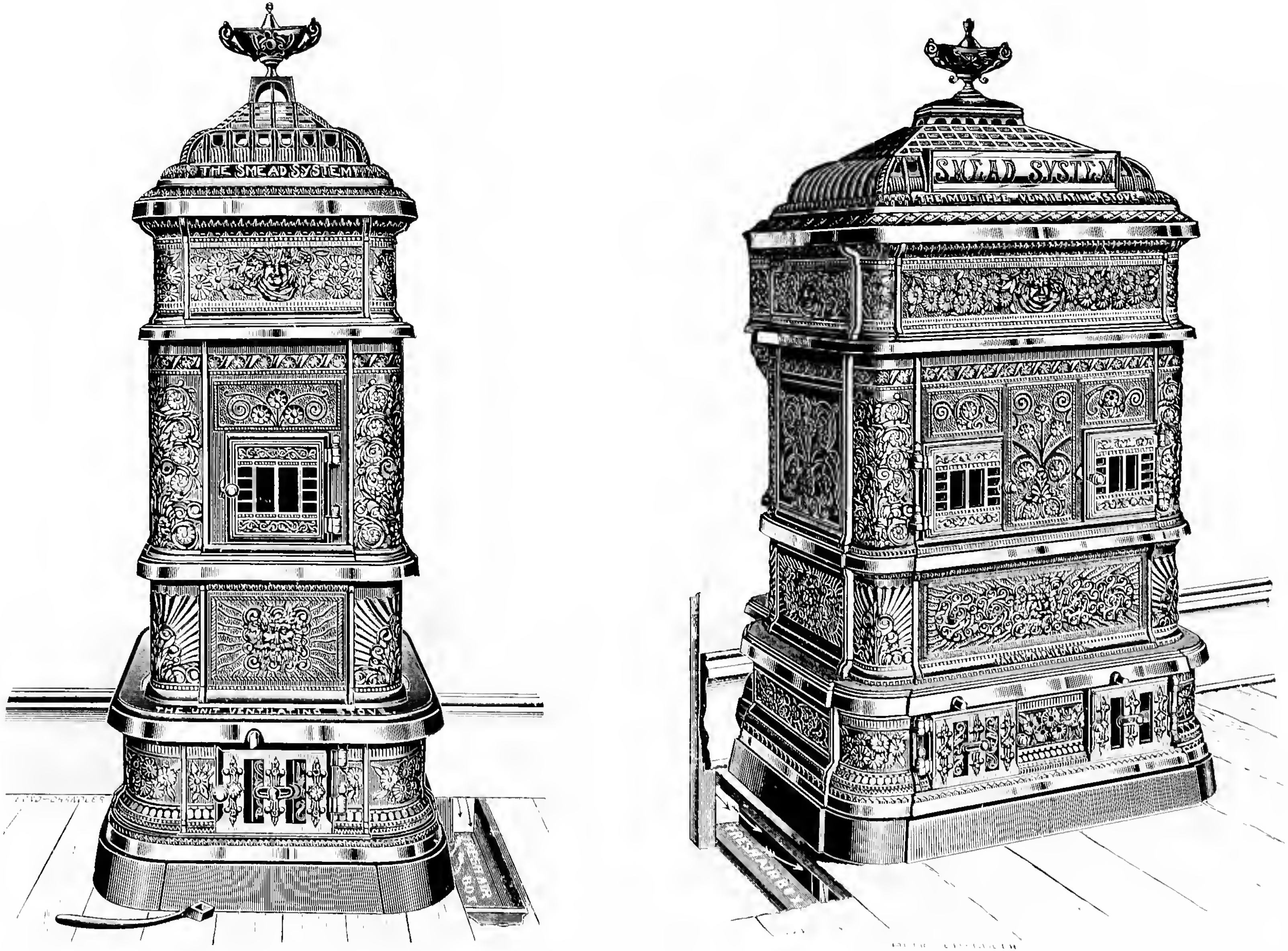


SECTION



THE MODEL DISTRICT SCHOOL.

The Model District and Ward School Building—Warmed and Ventilated by Smead's Schoolroom Heater.—Considerable sums are expended in arranging to warm and ventilate large school buildings, while the district school and ward buildings are always warmed with a common stove, and generally a *second-hand* one from some larger building, and no attention whatever paid to the important question of ventilation. Holes are left in the foundation walls through which the air can pass to prevent decay of joists and sills. This, of course, renders the temperature of space under the floor same as temperature outside (anywhere from 0 to 30° below), and the pupils sit all day with a board one inch in thickness between their feet and this sea of cold air, while their heads and bodies are in a temperature of from 40° to 90°, according to distance of seat from the stove, and this, too, in air which may have been breathed a dozen times. Who can wonder that they have cold feet, and are sometimes restless and unwilling to study, and that many are sick and unable to attend school more than one-half or two-thirds of the time? The plan of warming and ventilating buildings of this class, represented above, cannot but commend itself to all who will for a moment consider the two conditions. An entire change of air in the building every thirty minutes, temperature the same in all parts of the room, warm instead of cold air under the floor, should certainly be worth all it costs. For price of heater and registers, and other information on the subject, address SMEAD & NORTHCOTT, ELMIRA, N. Y.



THE UNIT AND DUPLEX SCHOOLROOM HEATERS. (Designed especially for hard coal.)

Town of Gates, District No. 4.
Gates Centre, April 27, 1889.

Messrs. Smead & Northcott, Elmira, N. Y.:

Gentlemen,—The ventilating heater which you put in our school in December, 1887, has given perfect satisfaction.

1. We can keep our schoolroom from 60° to 80° in any weather.
2. The room is an even temperature in every part, not varying over from 2° to 4° at a distance of four feet from heater and the back part of the room.
3. The ventilation is good; we always have pure air.
4. We use very little, if any, more coal than with the stove which warmed only a small part of the room in very cold weather.

Respectfully yours, J. L. Chase.

Leominster, Mass., April 22, 1889.

Messrs. Smead & Northcott, Elmira, N. Y.:

Gentlemen,—In reply to your inquiry of April 18, concerning results obtained by the schoolroom ventilating heater, of which we have four in use, I can say as follows:

1. We have been able to obtain comfortable temperature with the mercury at 15° below zero, starting fires at 6:30 in the morning.
2. The uniformity of temperature in different parts of the rooms is remarkable.
3. The ventilation is excellent.
4. As to the amount of fuel used as compared with other methods of warming schoolrooms, we find this is the cheapest that has come under our observation.

Respectfully yours, I. F. Hall, *Sup't of Schools.*

Jeremiah Smith, School Commissioner, Gates, Monroe Co., N. Y.
P. O. Address: Box 200, Rochester, N. Y.
Gates, N. Y., May 2, 1889.

Messrs. Smead & Northcott, Elmira, N. Y.:

Gentlemen,—I am glad to inform you that the schoolroom ventilating heater set up by you in December, 1887, at Gates Centre, has, from the first, given universal satisfaction. Both as a heater and as a ventilator it does perfect work. The even temperature in all parts of the schoolroom (24 x 40 x 16) is quite remarkable.

Our trustee informs me that by comparing his coal bills with those of other seasons the quantity used for the heater does not vary much from that consumed by a stove, with which the temperature could not be brought up to a comfortable point in winter weather, to say nothing about ventilating.

Entering frequently, as I have done, ill-ventilated schoolrooms, where the atmosphere was oppressive, prepares me to appreciate a perfect ventilating and heating system, and to discover, beyond the possibility of a doubt, the most potent health destroyer—*vitiated air.*

I am confident that people must soon be taught to appreciate a perfect heating and ventilating system, and that the old style stove *must go.*

I am, gentlemen, yours respectfully, Jeremiah Smith.

Lake View, N. Y., May 5, 1889.

Smead & Northcott, Elmira, N. Y.:

Gentlemen,—Yours of April 18 received. The heater in use in our schoolroom the past two winters gives perfect satisfaction. We have never noticed a difference of over four degrees in temperature in any part of the room at same height from floor. The coldest, windiest days last winter the temperature was kept above 70 without the least trouble, and frequently the cooling damper was lowered. As to the ventilation, we have no scientific tests, but the air is always fresh, and no complaints of headache, etc., we so often hear of in unventilated schoolrooms. Our room is 26 x 32 with 12-ft. ceiling.

Very truly yours, Geo. B. Cole, *Trustee Dist. No.* 12.

HOW TO SELECT WARMING AND VENTILATING APPARATUS.

> "THERE IS A PRINCIPLE WHICH IS A BAR AGAINST ALL INFORMATION, WHICH IS PROOF AGAINST ALL ARGUMENT, AND WHICH CANNOT FAIL TO KEEP A MAN IN EVERLASTING IGNORANCE. THIS PRINCIPLE IS, CONTEMPT PRIOR TO EXAMINATION."—*Dr. Paley.*

ONE of the greatest farces enacted by any man or set of men is that one very frequently enacted by boards of education and other committees having in charge the construction of public buildings. Yet, I do not know that they are entirely at fault, nor am I sure that I can make plain a better method than the one usually adopted. They generally know little or nothing about the subject of warming and ventilating or of the various kinds of apparatus in use; they simply know that they must buy some kind of a heater, and as they work without pay can give but little attention to the matter. They postpone the letting of the contract as long as possible, then invite bids, get themselves in position to be talked to by the "*agents*," allowing each "agent" say thirty minutes to teach them all he knows upon the subject. (Ample time I admit for the majority to tell all they know of the matter, if we may judge of their knowledge by their works!!) But suppose there is among those who bid on the work to be done a careful, competent, conservative and experienced engineer, who has given a score of years to the learning of the business, who has had several hundred buildings under his personal supervision, and who is honest enough to acknowledge that he has made many mistakes in the past and is anxious to avoid them in the future, and who may have spent from $200 to $500 in preparing plans and estimates on the building under consideration, and who may have discovered serious errors in original construction or in the plans prepared by the architect—errors which if not corrected would, to his positive knowledge, cause a failure, no matter what apparatus might be used. Can he in thirty minutes' time explain all these details and teach the committee a business it has taken him years to learn, or make clear to them a set of plans it may have taken him two weeks to design? Manifestly not. It is preposterous to suppose he could, and especially if he be met with and have to deny or explain a lot of statements that some "agent" or visionary "salesman" may have presented to the committee before his appearance. They (the "agents") may have told the committee that away down in some obscure corner of some distant state, "away back when Adam was a boy," the —— system was a failure, and that the systems used by all others than themselves had "been used by the Chinese four thousand years ago." And after answering all these statements, how much time is left him of this "thirty minutes" in which to explain to the committee who cast the vote, and of whom perhaps not more than two or three know the difference between a plan of a building and a map of Europe. How much time I say has the engineer left to explain his methods as represented probably by an expensive set of drawings absolutely necessary to the proper execution of the contract? First-class work in any line always costs more than second or fourth class, and as it is fair to suppose that the *student* knows more than he who has *never studied*, it is as fair to presume that a carefully prepared estimate is higher than one that is "guessed at."

I can assure the reader that it is often mighty up-hill work to get a majority vote for the best apparatus from the wise men who have devoted possibly three hours to the question. I was recently given an hour in which to answer the arguments (?) of four "salesmen," three of whom had never warmed a building one-third the size of the one under consideration, and to explain a set of plans it had cost me $200 to prepare (no designs had been submitted by the others). I was also asked to make plain to these wise men why my bid, on which there was not a profit to exceed ten per cent, was over $4,000 higher than any of the others submitted and more than $6,000 more than the lowest. It *could not be done*, and I refused to attempt it, and the cheapest apparatus was voted in by the executive committee; but the vote was afterwards reconsidered, and, owing to the earnest, honest efforts of a few members, faithful to the best interests of those who would be obliged to occupy the building (a state university), the contract was awarded to me. There are many "agents" running around the country selling "hot-air furnaces" and steam fixtures whose stock argument is that someone else has made a failure somewhere (and that generally a long distance off), and who know no more about the business of successful engineering than the average quack who hawks "patent medicine" about the country knows of surgery. No matter how the building may have been planned and constructed, "it is all right," and all the occupant requires to complete his happiness is the possession of their "Eureka" or "Florida." "Any hardware dealer or steamfitter can set it in position, and any ten-year-old boy can manage it, and no matter what the quantity of fuel used, the result will be the same!" They will recommend, say, a 50-inch furnace for a residence containing 20,000 cubic feet, and two of the same size for a church or opera house containing 200,000 cubic feet, and of course in the latter instance there can be but one result and that, failure. Now I have, and at a considerable length, stated the condition of affairs as they exist, and the reader would like some recommendation as to the course to be pursued by a committee who wish to avoid the errors referred to. I can only urge *investigation*; honest, careful investigation. The principles governing the question of warming and ventilating are easily understood, but the reader must bear in mind that the successful application of these principles *depends upon the knowledge and skill of the engineer* in charge of the work, and his knowledge and skill depend largely upon his *experience*. Concerning this, the customer must decide, and it is for this reason I have presented for consideration a large amount of evidence attesting the success of the work I have done. I do not claim that in an experience of twenty years I have made no mistakes, either in construction or estimates. I have made *many*, but never the same one *twice* to my knowledge, and have corrected all *at my own expense*, whenever possible for me to do so.

LIMA, Ohio, March 20, 1889.

ISAAC D. SMEAD & CO., Toledo, Ohio:

Gents,—Yours of the 12th inst., in relation to satisfaction in the use of the heating apparatus and dry closet system as furnished by you for our 3d Ward school building, was duly received and noted. My term of office expired after the board had contracted with you and during the construction of the building—I had served the district for a period of fifteen years and concluded to take a rest—hence I have delayed replying to your inquiries until I could meet some members of the present board and the superintendent and learn what they had to say. In relation to the heaters, from present indications they will meet all requirements. As to the dry closet system, for convenience, cleanliness and morality it cannot be excelled as an appliance to a school building, it being so closely under the eye of the janitor no obscene writing or pictures can be made or bad talk indulged in without the guilty ones being detected. All with whom I have consulted are highly pleased with the equipment. Very truly yours, THEO. MAYO.

CAUTION.

WE are constantly being informed of instances where our SYSTEM OF VENTILATION, WITH OUR IMPROVEMENTS, has been introduced by parties either representing themselves as our agents, or that we have no patents to protect our rights. We are charged with the failure to warm buildings of which we KNOW NOTHING until we hear the reports so detrimental to our interests.

So far as we are able to learn, these reports are started and circulated by those having CHEAP, LIGHT furnaces, and no system of ventilation. We have paid several thousand dollars for patents, and many thousands more have been expended to *perfect* the system. Patents have been granted for our improvements, and WE SHALL COLLECT A ROYALTY WHENEVER THEY ARE USED.

Any parties now using (without our consent), or desiring to use, the systems of ventilation, must correspond directly with us as we have no agents.

GUARANTEE.

All contracts made by us contain the following guarantee, to wit:

"We hereby guarantee that the said furnace(s) shall, with good care, warm the...................... rooms of said building to an average temperature of from 65° to 70° Fahrenheit during the *coldest weather*, and at the same time secure good ventilation in all rooms warmed. Provided the furnace(s) do(es) not fill the above guarantee, we agree either to make it (them) do so at our own expense, or refund all money paid us and remove the furnace(s) from the building."

For the additional sum of dollars, payable when furnaces are set in position, party of first part agrees

to furnish vault heaters @ $ each, - - - - - $

.... 24 inch cast-iron seats @ $.............. each, - - - $ ....

.... 30 " " " " @ $ " - - $

feet of iron floor @ $ .... per foot, - - - $ ....

feet of urinal @ $ per foot, - - - $

Right to use Closet System, - - - - - - - - - - - - $

as shown on plans, and to permit the use of the Isaac D. Smead system of dry closets, and to furnish plans and specifications showing proper construction of the same. Said closets to be constructed at the expense of the party of the second part, and strictly in accordance with said plans and specifications, and under these conditions the party of the first part guarantees the successful operation of the dry closet system.

MAYVILLE, Mich., March 19, 1889.

TO WHOM IT MAY CONCERN:

The Smead system has been in use in our new school building for seven months, and it has given the best of satisfaction in every respect. The daily attendance has been greatly increased on account of the ventilation. Nine of the forty pupils enrolled the first month of our last year in one old house attended every day. Nine of the forty-two enrolled the second month attended every day, and ten of the forty-four enrolled the third month attended every day.

Thirty-four of the fifty pupils enrolled the first month of the present school year attended every day. Forty-one of the forty-four enrolled the second month attended every day, and thirty-nine of the sixty enrolled the third month attended every day.

The dry closets work to perfection. I believe it to be the best heating and ventilating system in use.

Yours truly, (Signed) E. D. DIMOND,
Principal.

STOVE GASES.

WROUGHT-IRON VS. CAST-IRON AND CARBONIC OXIDE.

To the Editors of the Boston Daily Advertiser:

During the past four or five years much has been written and said in regard to the effects of cast-iron used in the construction of stoves and furnaces. Cast-iron, it has been said, allows poisonous gases (carbonic oxide, carburetted hydrogen, sulphur compounds, etc.) to pass freely through its pores, even at temperatures below redness. Wrought-iron was claimed to be free from this objection.

Certain experiments made under the direction of the French Academy have been quoted in proof of these statements, but have been so exaggerated, either by ignorance or from selfish motives, that there is a great misapprehension on the part of the public in regard to the real facts of the case.

Furnaces and stoves have been invented, claiming to obviate the difficulties alleged, and recently the matter was brought before a scientific body in this city, where the great dangers said to arise from the use of cast-iron were freely discussed.

These dangers have been greatly exaggerated and overrated. What are the facts? In 1863–64 Deville and Troost, at Paris, discovered that various metals—platinum, iron, etc.—were permeable to gases at a bright red heat; this permeability was only slight, for after several hours traces only of certain gases found their way through. Dr. Carrett, in 1865, and Gen. Morin, in 1868, brought their experiments to the notice of the French Academy, and suggested the appointing of a commission of scientific men to report upon the extent to which cast-iron stoves were detrimental to the public health. At the same time Gen. Morin presented the results of several experiments, upon which all of the cry against cast-iron has been based. These experiments were made with *soft coal* (which, as is well known, yields more gaseous products than anthracite), and stoves of cast-iron *only one-tenth of an inch thick.* The stoves were heated to a red heat, yet in the concluding experiment, lasting twenty-seven hours, there was produced in the 250 liters of air in a close vessel surrounding the stoves about $\frac{4}{100}$ of a liter of carbonic oxide, or only one part of this poisonous gas in 6,000 parts of the confined air. Had the gas produced in twenty-seven hours escaped into a room of 1,000 cubic feet capacity—a room without the slightest ventilation—there would have been found in 625,000 parts of air only one part of carbonic oxide. If such a room were ventilated, is it possible that the air at any given time would have been poisonous? Even this small quantity of carbonic oxide did not pass *through* the cast-iron, for by far the greater part of it was developed on its outer surface, as the subsequent report of the commission shows. A commission was appointed to fully investigate the matter. Among its members were Fremy, Payen, St. Clair, Deville and Gen. Morin, and after a series of experiments lasting more than a year, a full report was made. No one of those who have said so much against cast-iron seems to have given this report any notice. It is contained in the Comptes Rendus, May 3, 1869. After detailing at considerable length their various experiments and methods showing the production of carbonic oxide in small quantities, under certain circumstances, by stoves of either wrought or cast iron, they report:

The results indicated above are produced *only when the metal is brought to a red heat.*

The most immediate effects are those due to the direct radiation of these surfaces, and in this respect *there is no difference between wrought and cast iron.*

The report further shows that carbonic oxide is produced mainly by the following causes:

I. The direct action of the air upon the carbon in the iron heated to redness.

II. The decomposition of the carbonic acid in the air by its contact with the metal heated to redness.

III. The influence of dust and organic matters naturally contained in the air.

The commission further report that a development of carbonic oxide may take place from wrought-iron stoves brought to a red heat, and they close with the statement:

By lining stoves with fire brick or clay all the inconveniences noted may be avoided.

It is far from my purpose to underrate the great importance of having the air of our houses as pure as possible, and of avoiding the slightest presence of carbonic oxide or other dangerous gases; but it seems to me very wrong that sensational stories should be circulated in the name of science, and facts exaggerated, causing unnecessary alarm in regard to matters of great interest to the public.

Our stoves and furnaces too often emit dangerous gases, but it is not the cast-iron "permeated by these gases at every pore" that is at fault; it is the red-hot surfaces acting upon the air itself; the imperfect dampers; the dust in the air. Let us hope we may hear no more of this great scare about poisonous gases coming through the pores of cast-iron in a furnace an inch thick.

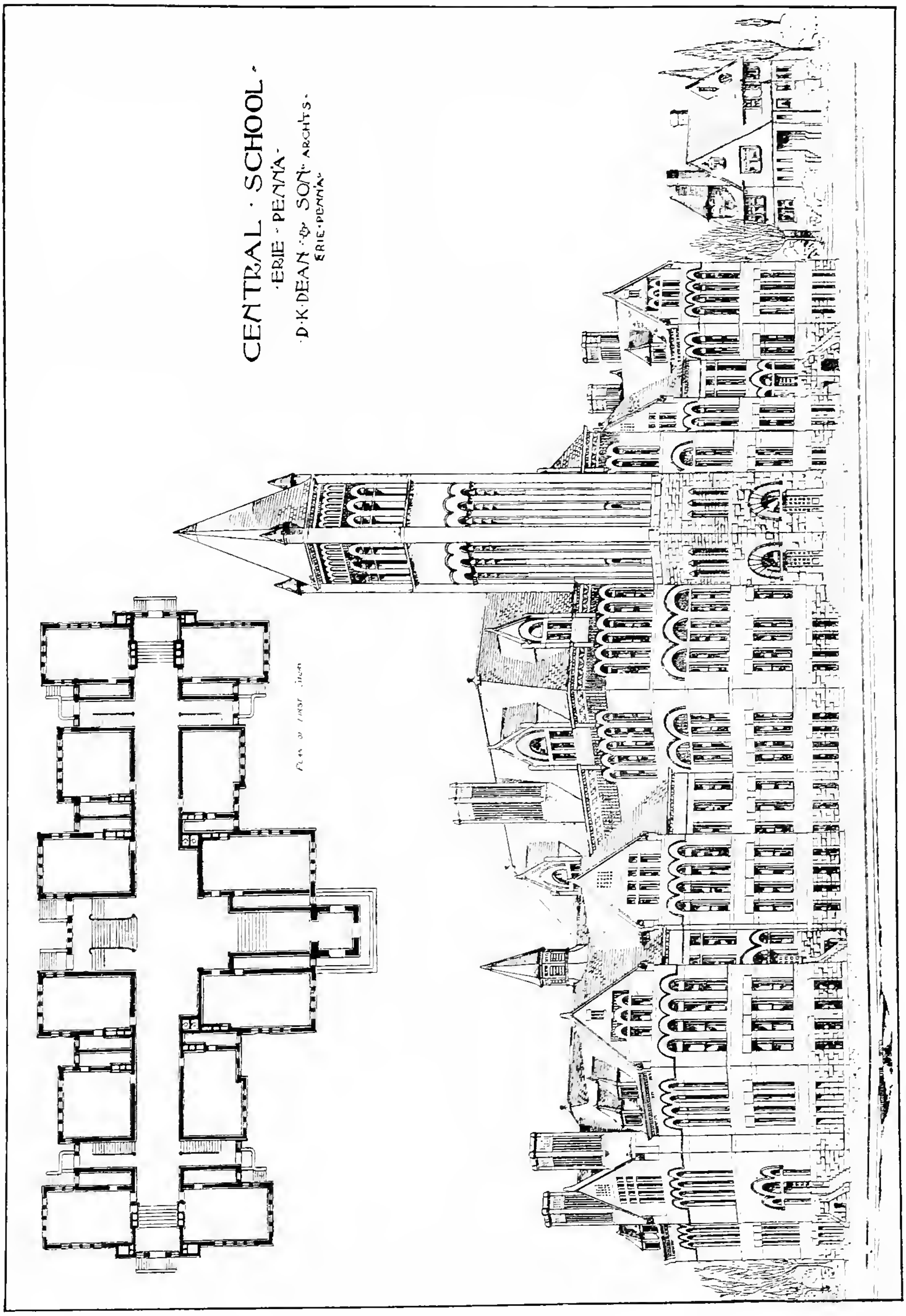
Respectfully,

No. 8 Boylston St., Boston, June 6.

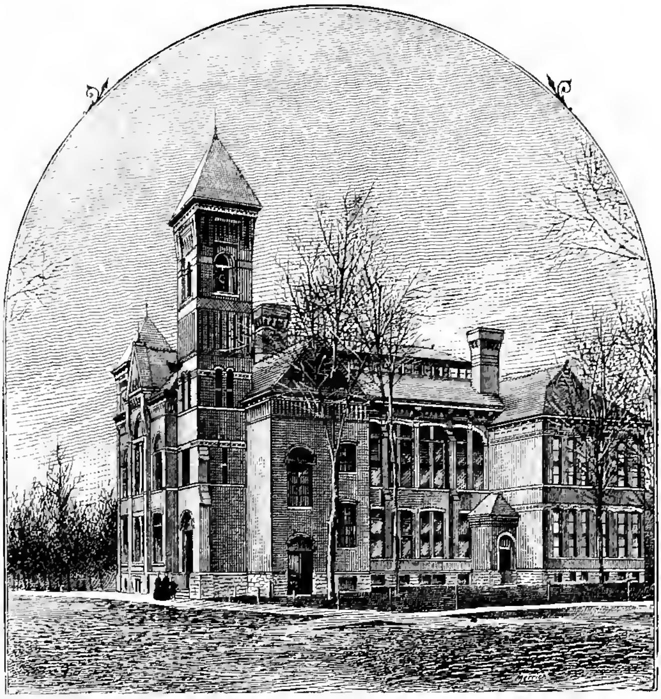
James F. Babcock.

OPINION OF A WELL-KNOWN SCIENTIST.

Prof. Kedzie, of the Michigan Board of Health, contradicts the notion that has been so industriously circulated of late years that gas will not escape through the walls of wrought-iron furnaces. It will not penetrate them as readily as cast-iron, but will pass through if highly heated. Cast-iron furnaces are good enough if large enough, so as to furnish sufficient warmth without being overheated, if the joints are well closed with cement, and if no dampers are allowed in the pipe to obstruct the passage of the gas into the chimney. Moreover, cast-iron radiates heat better than wrought-iron.



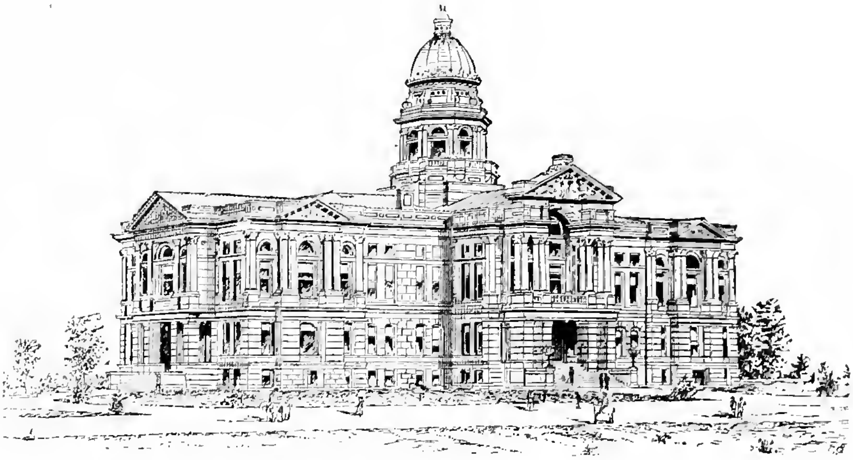
Warmed and ventilated by the Smead system.



HIGH SCHOOL BUILDING, ITHACA, N. Y.

A. B. WOOD, ARCHITECT, ITHACA.

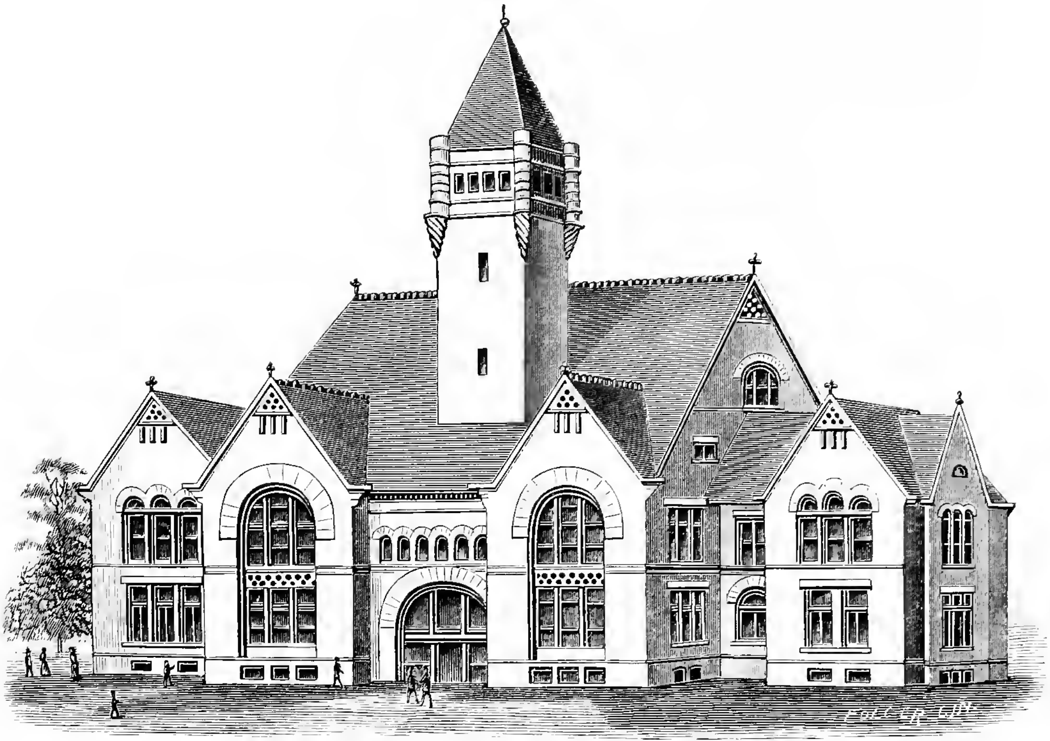
Warmed and ventilated by the Smead system.



STATE CAPITOL BUILDING, CHEYENNE, WYO.

D. W. GIBBS & CO., ARCHITECTS, TOLEDO, OHIO.

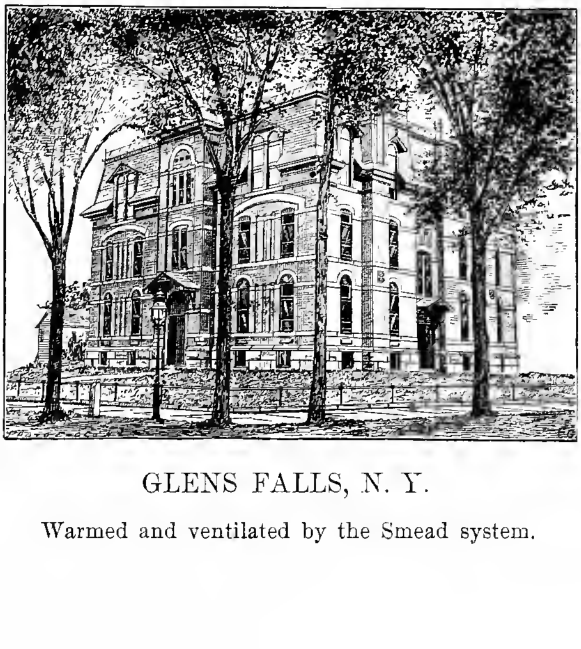
Warmed and ventilated by the Smead system.



TWENTY-THIRD STREET SCHOOL BUILDING, COLUMBUS, OHIO.

J. W. YOST, ARCHITECT, COLUMBUS, OHIO.

Thirteen school buildings in Columbus warmed and ventilated by the Smead system.

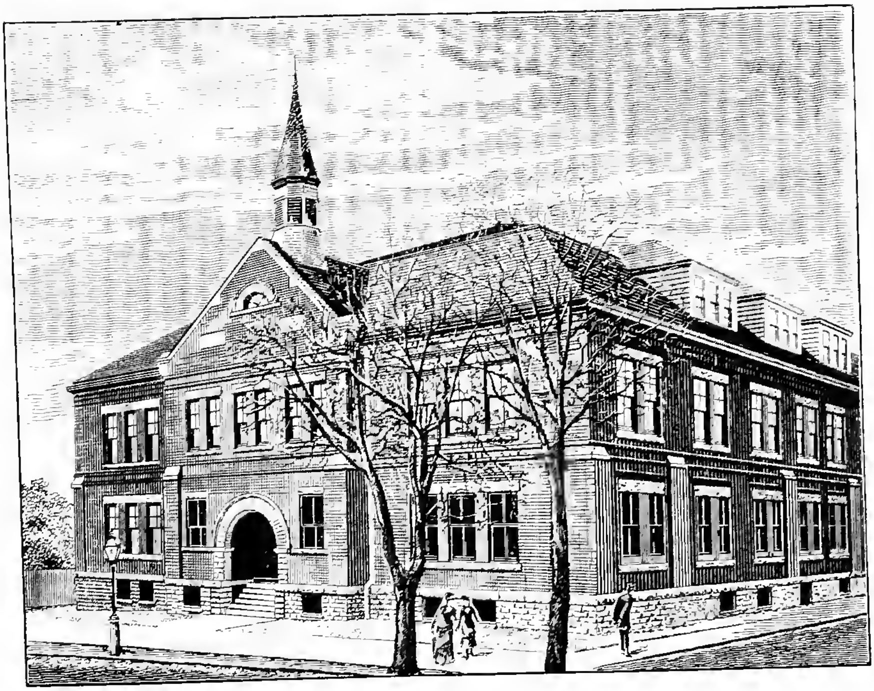


GLENS FALLS, N. Y.

Warmed and ventilated by the Smead system.

RESIDENCE OF ISAAC D. SMEAD, TOLEDO, OHIO.

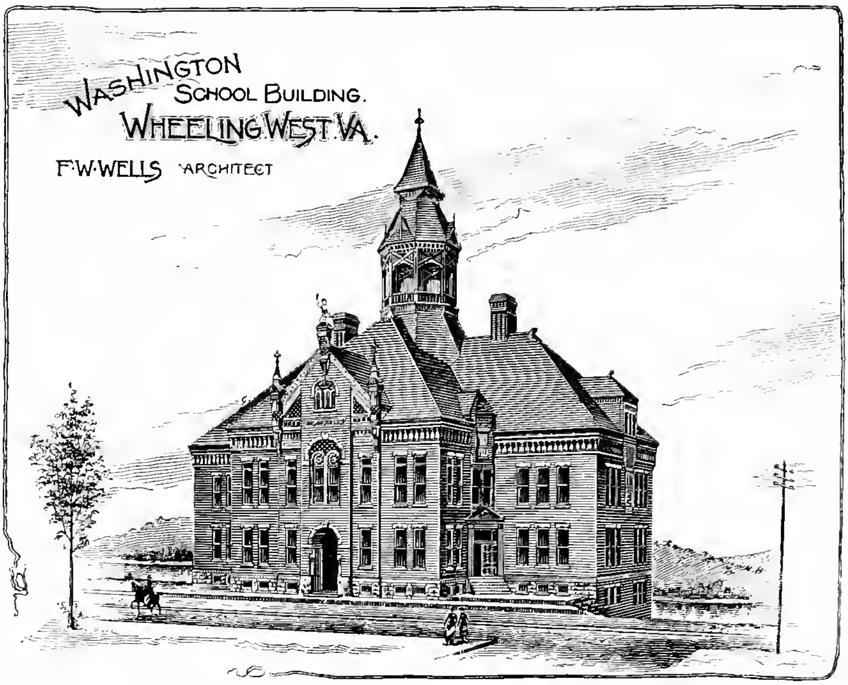
Warmed and ventilated by the Smead system.



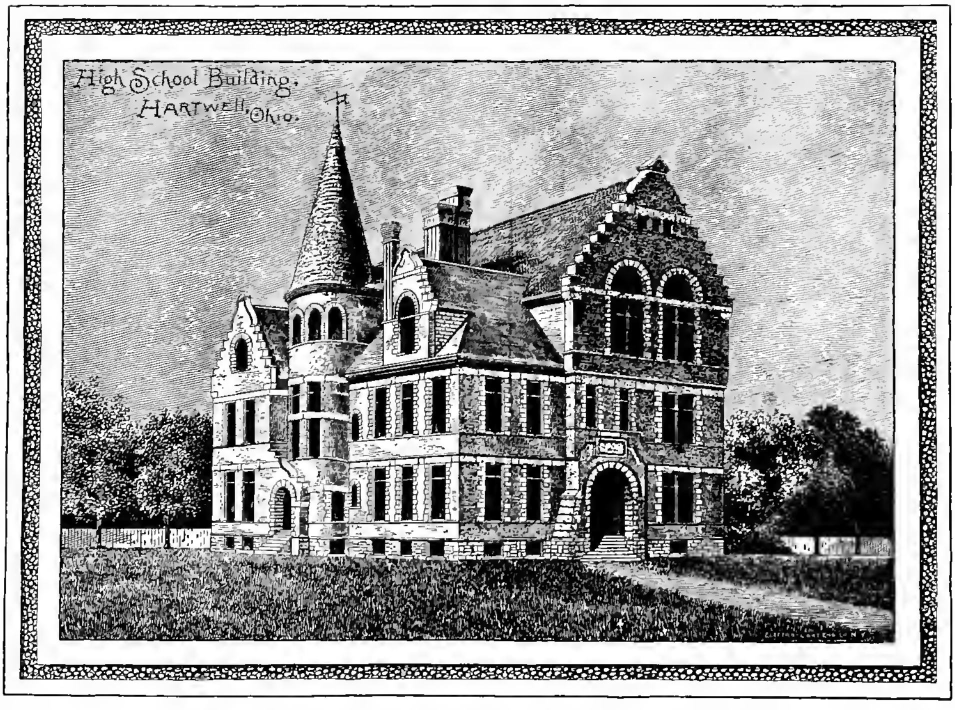
No. 14 SCHOOL BUILDING, ROCHESTER, N. Y.

O. K. FOOTE, ARCHITECT.

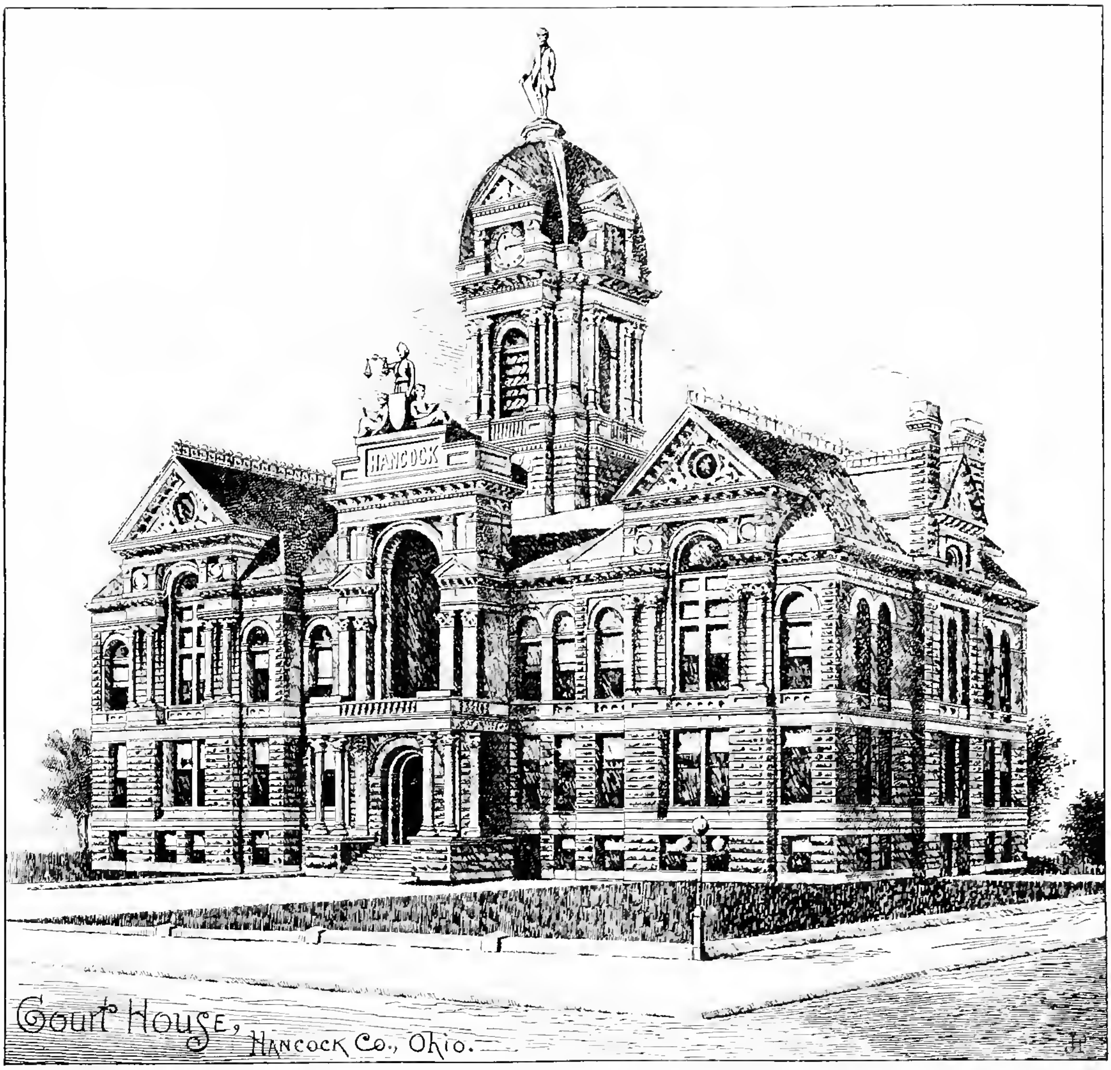
Warmed and ventilated by the Smead system.


WASHINGTON
SCHOOL BUILDING.
WHEELING WEST VA.
F·W·WELLS ARCHITECT

Warmed and ventilated by the Smead system.



Warmed and ventilated by the Smead system.

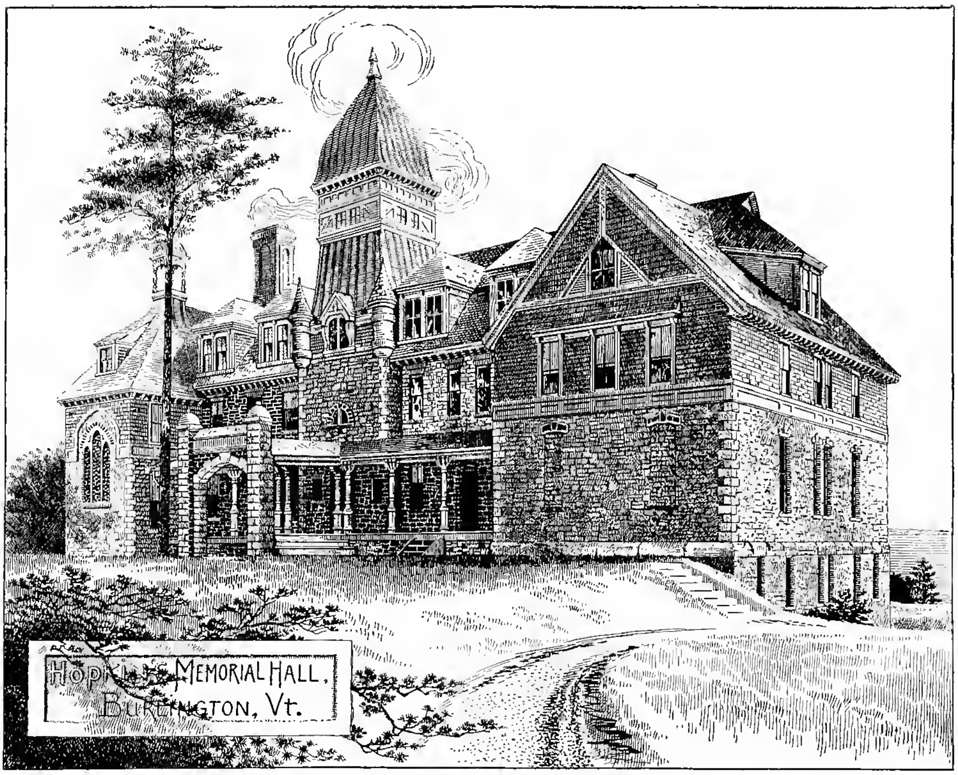

HANCOCK
Court House, Hancock Co., Ohio.

WEARY & KRAMER, ARCHITECTS, AKRON, OHIO.

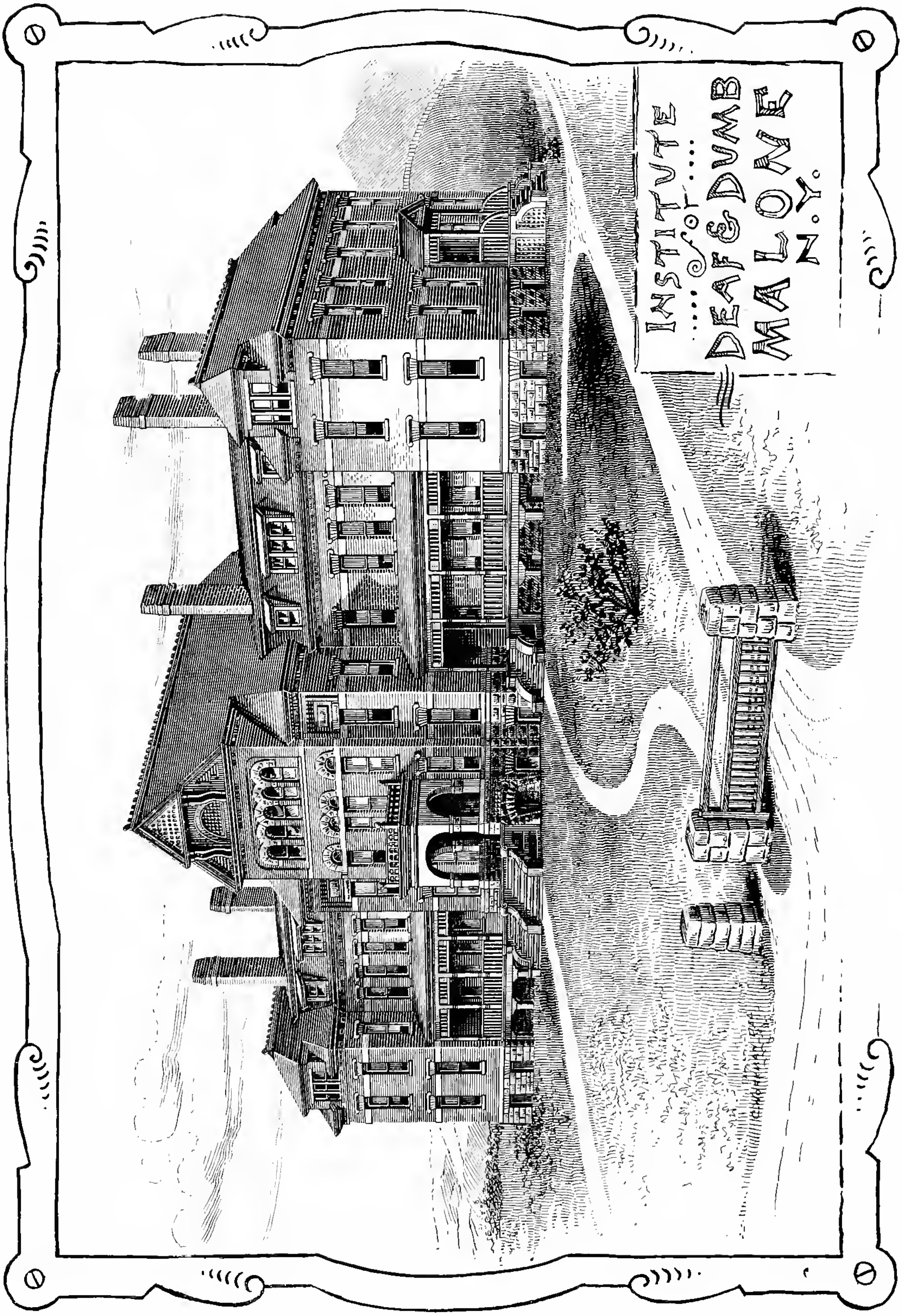
Warmed and ventilated by the Smead system

A. S. WAGNER, ARCHITECT, WILLIAMSPORT, PA.

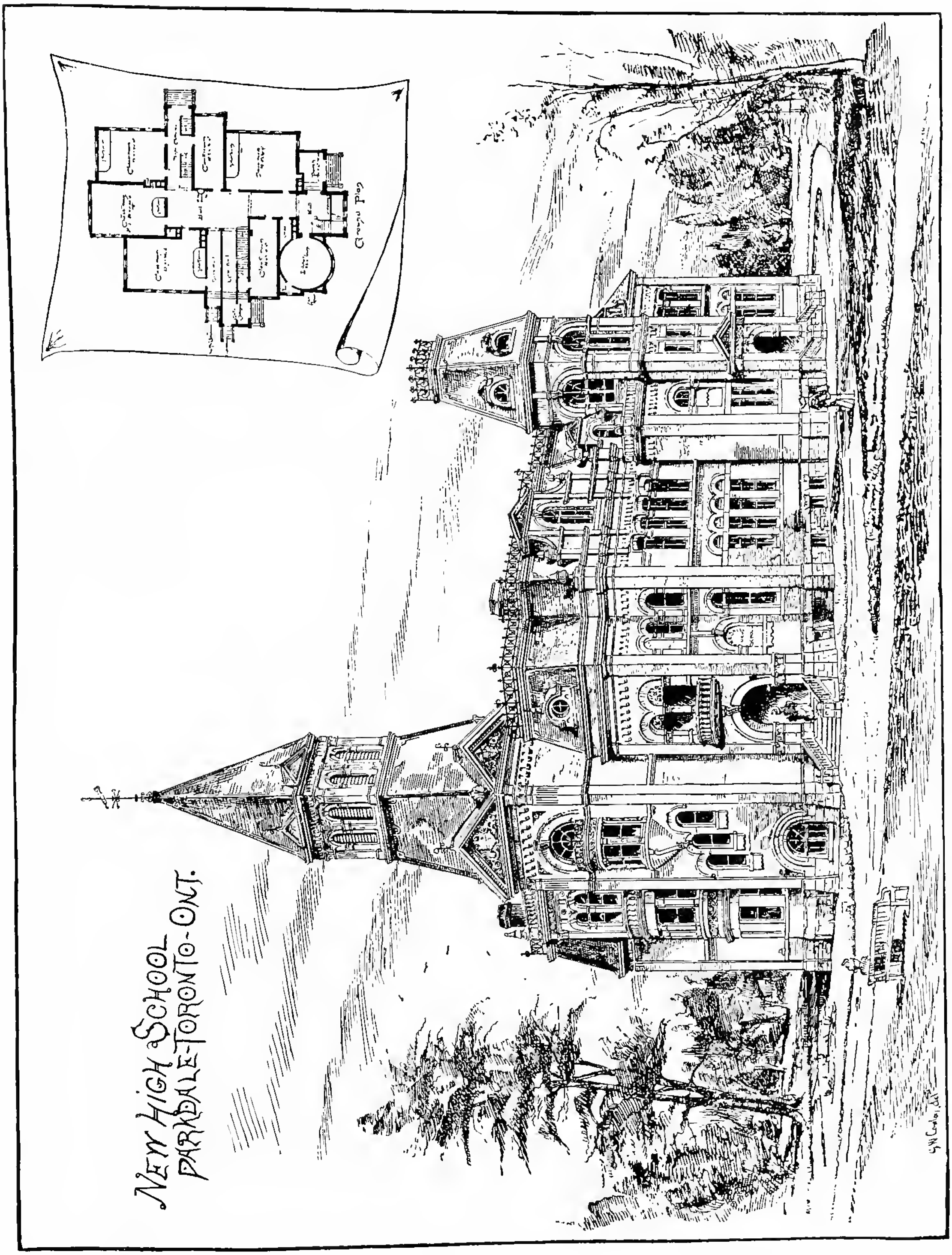
Warmed and ventilated by the Smead system.



Warmed and ventilated by the Smead system.



J. P. JOHNSTON, ARCHITECT, OGDENSBURGH, N. Y.
Warmed and ventilated by the Smead system.



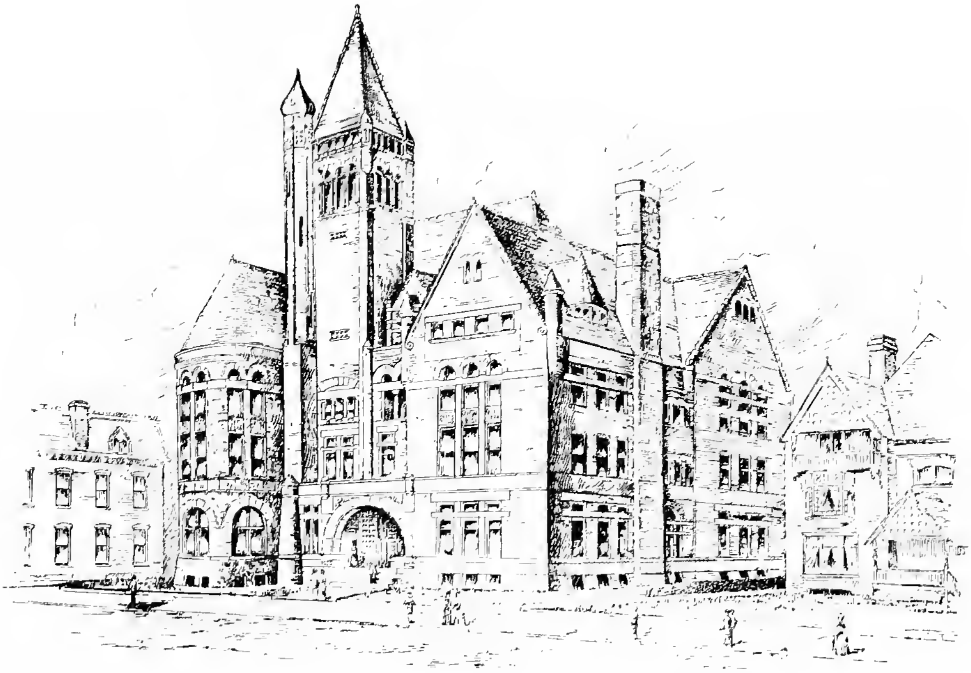
Fourteen school buildings in Toronto warmed and ventilated by the Smead system.

(Smead, Dowd & Co., Contractors, Toronto.)

FIFTH AVENUE SCHOOL BUILDING, COLUMBUS, OHIO.

S. J. HALL, ARCHITECT, COLUMBUS, OHIO.

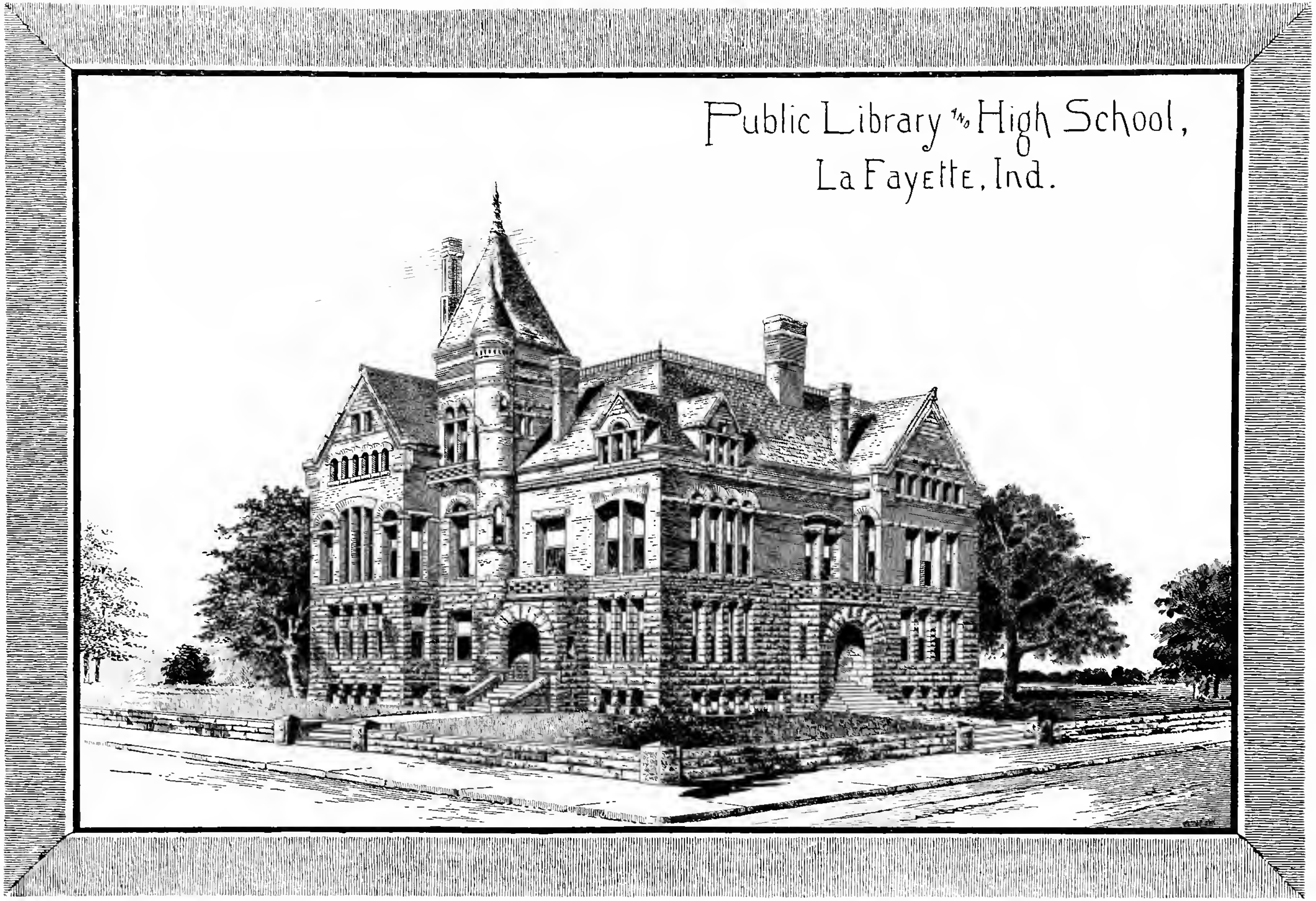
Thirteen school buildings in Columbus warmed and ventilated by the Smead system.



CENTRAL HIGH SCHOOL, ALLEGHENY, PA.

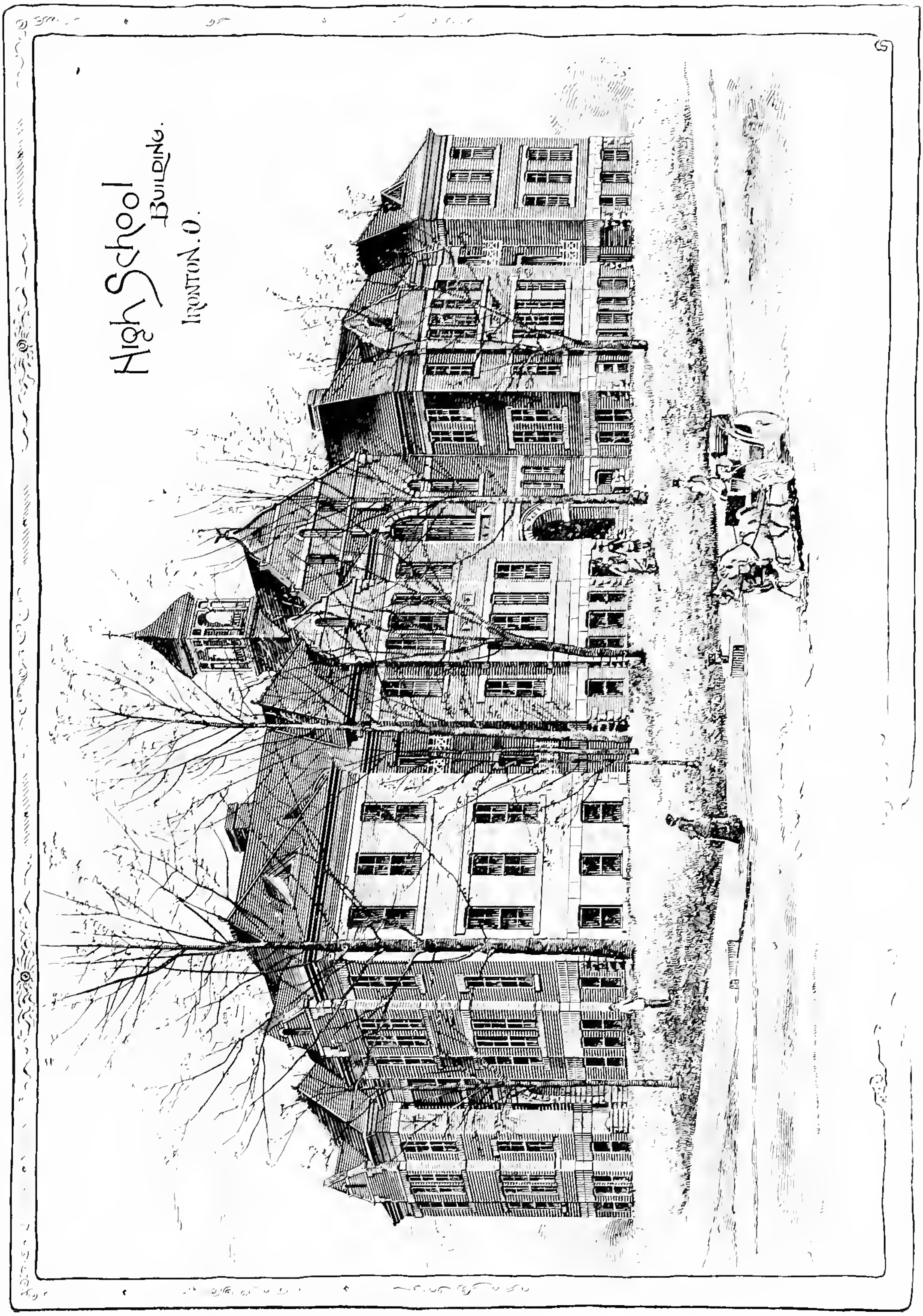
J. F. OSTERLING, ARCHITECT.

Warmed and ventilated by the Smead system.


Public Library and High School,
La Fayette, Ind.

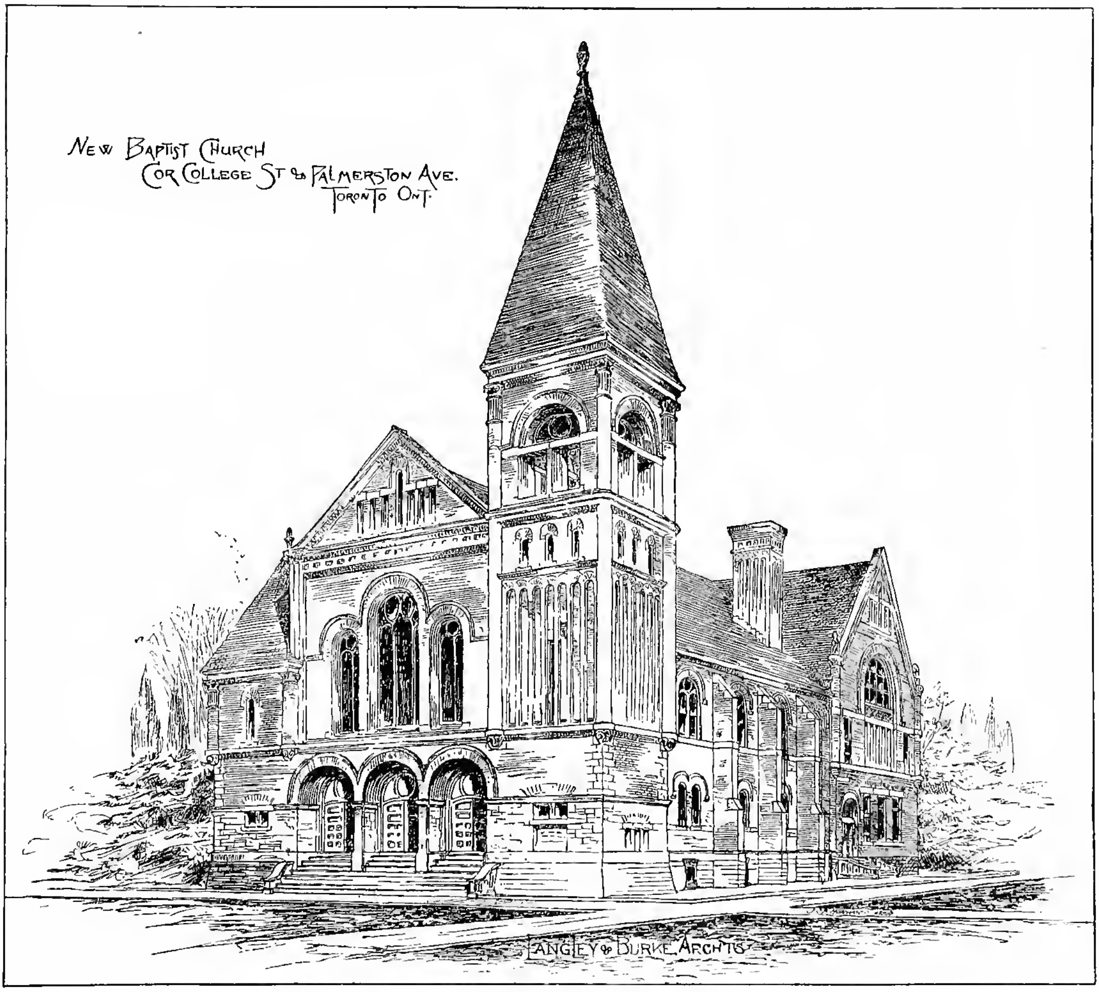
JAS. F. ALEXANDER, ARCHITECT, LA FAYETTE, IND.

Warmed and ventilated by the Smead system.


High School Building.
Ironton, O.

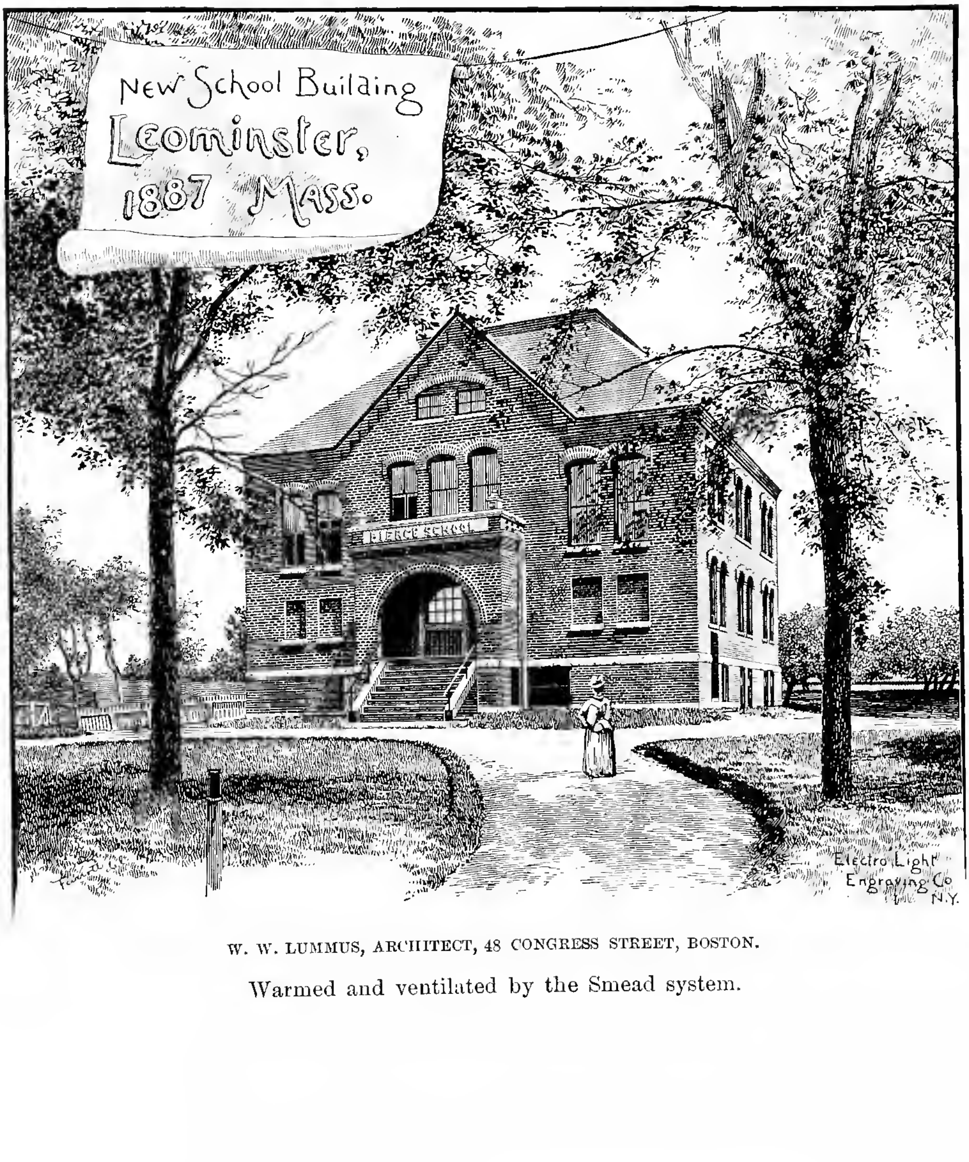
S. FLOYD BOARD, ARCHITECT, CEREDO, W. VA.

Warmed and ventilated by the Smead system.


New Baptist Church
Cor College St & Palmerston Ave.
Toronto Ont.
Langley & Burke Archts

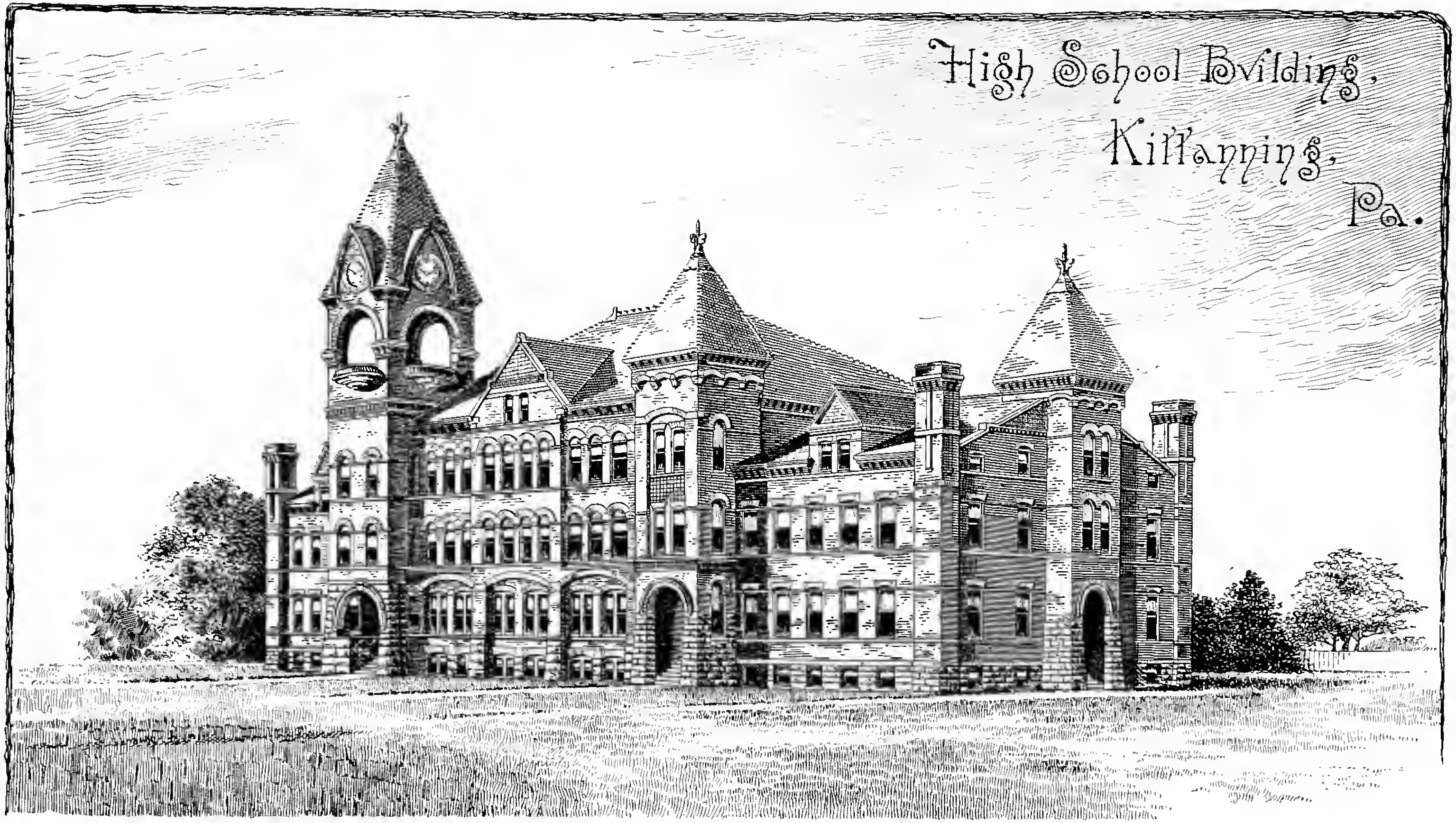
Fourteen school buildings in Toronto warmed and ventilated by the Smead system.

(Smead, Dowd & Co., Contractors, Toronto, Ont.)



W. W. LUMMUS, ARCHITECT, 48 CONGRESS STREET, BOSTON.

Warmed and ventilated by the Smead system.



Warmed and ventilated by the Smead system.

Kittanning, Pa., March 28, 1887.

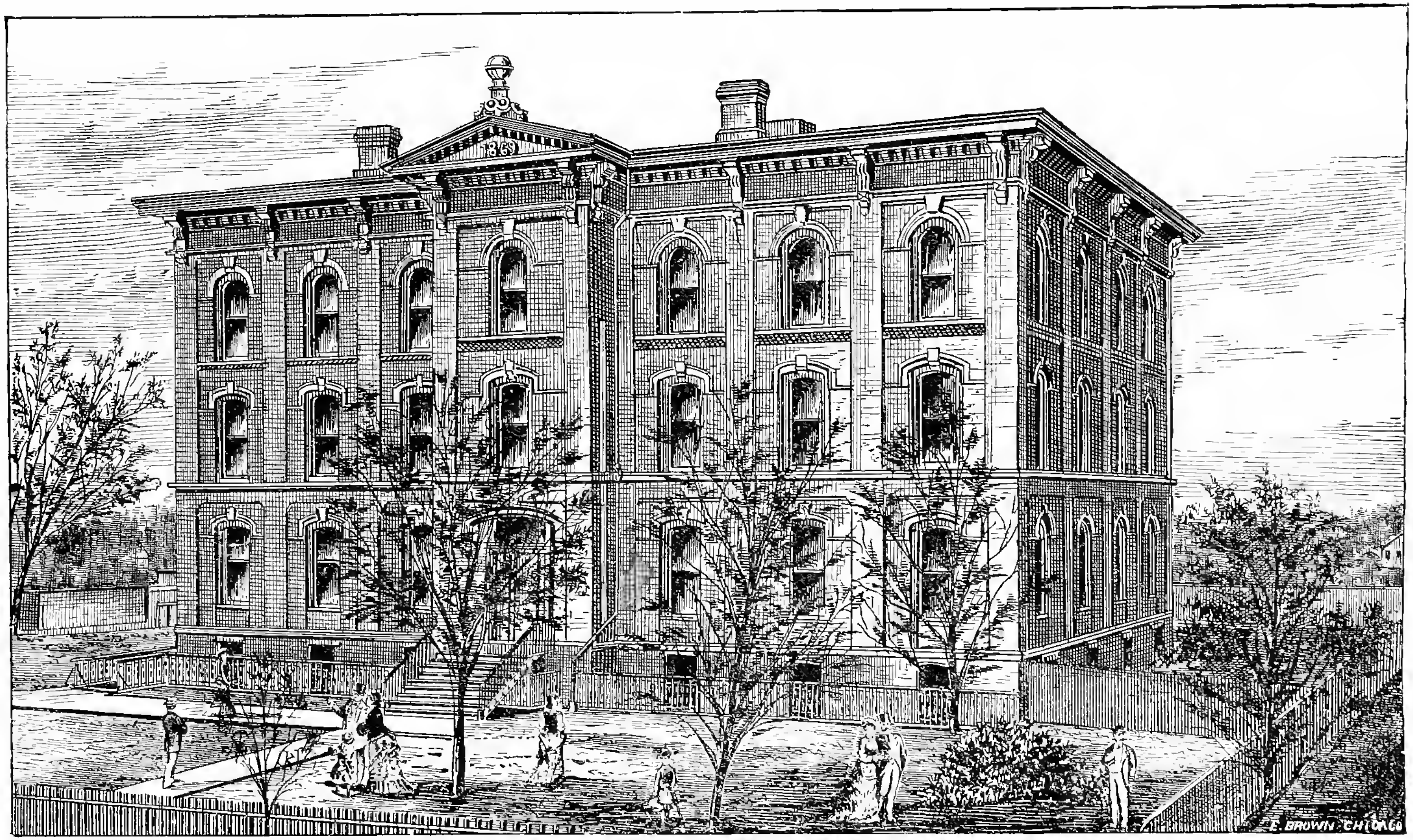
Messrs. Smead, Wills & Co.:

The Smead heating and ventilating system, now in use in the Kittanning public schools, has given entire satisfaction. There are sixteen schoolrooms in the new school building on the first and second floors, and a large assembly room on the third floor; these can easily be kept at any desired temperature with the four pairs of heaters placed in the building.

Your ventilating system is especially satisfactory. The constant supply of fresh air, its equal distribution throughout the building and the admirable arrangement for carrying off the foul air, all combine in giving the best results, both in the matter of heating as well as in ventilating the rooms.

The dry closet system is working admirably, and we believe will accomplish all you claimed for it. We take pleasure in attesting that your entire plan of heating, ventilating and of dry closets has thus far given entire satisfaction, and we have no hesitation in commending the whole plan to all persons who will give it a fair trial.

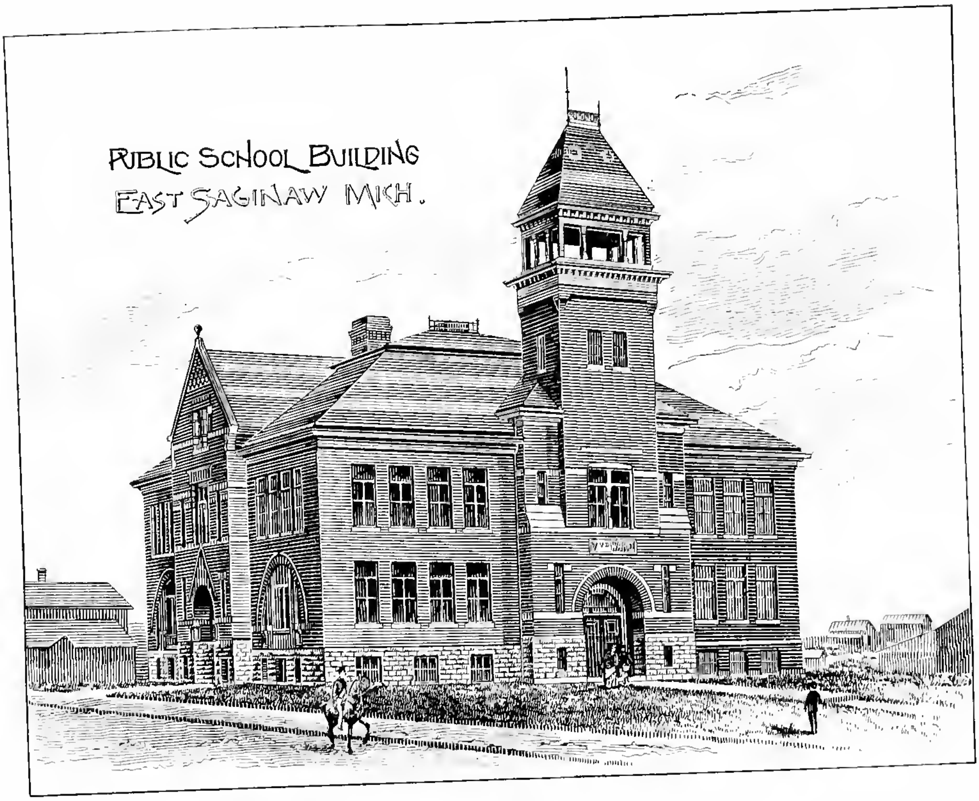
By order of the Kittanning School Board,
E. S. Golden, *President.*
James P. Colter, *Secretary.*



HUMBOLDT, BROADWAY, JEFFERSON, STICKNEY AND FRANKLIN SCHOOL BUILDINGS, TOLEDO, OHIO.

Twenty-six school buildings in Toledo now warmed and ventilated by the Smead system.

(Twelve formerly heated by "Hot-Air Furnaces.")



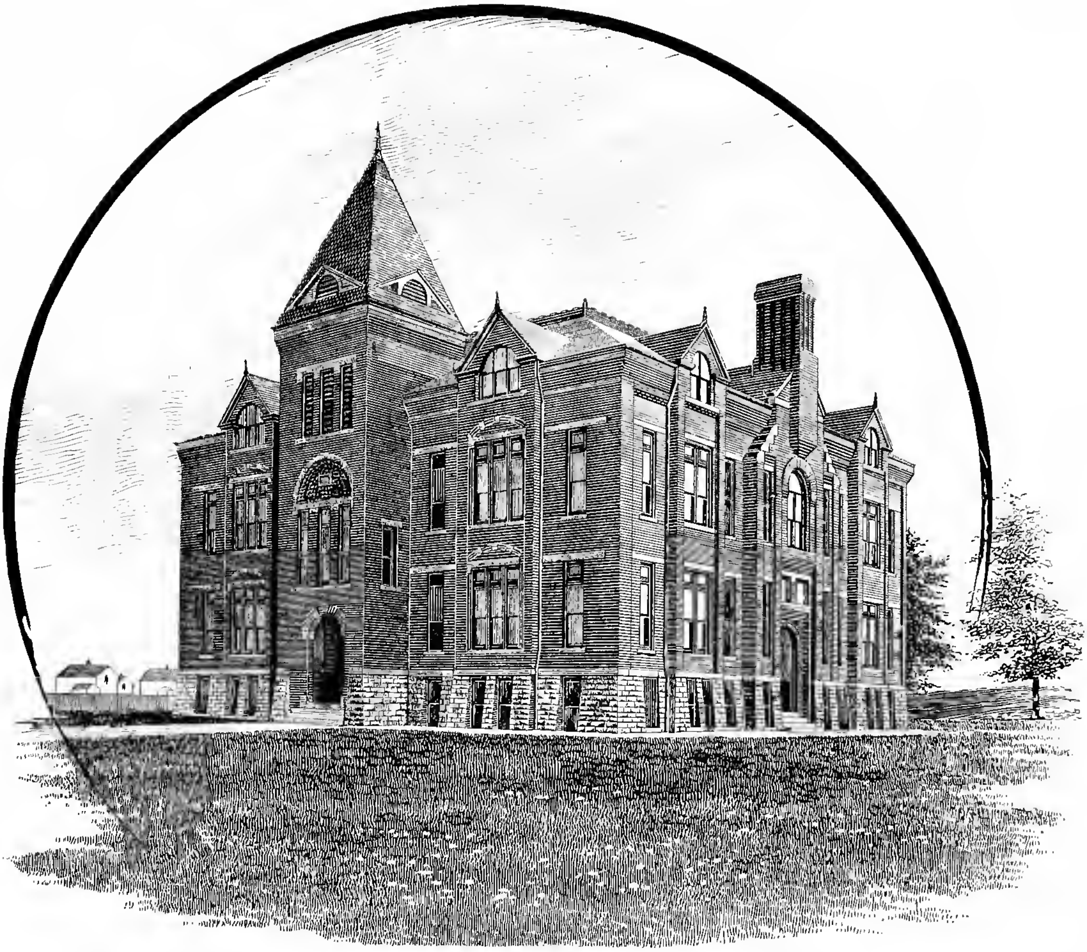
F. W. HOLLISTER, ARCHITECT, SAGINAW, MICH.

Nine school buildings in Saginaw warmed and ventilated by the Smead system.

ILLINOIS STREET SCHOOL BUILDING, TOLEDO, OHIO.

HENRY C. CONRAD, ARCHITECT, TOLEDO, OHIO.

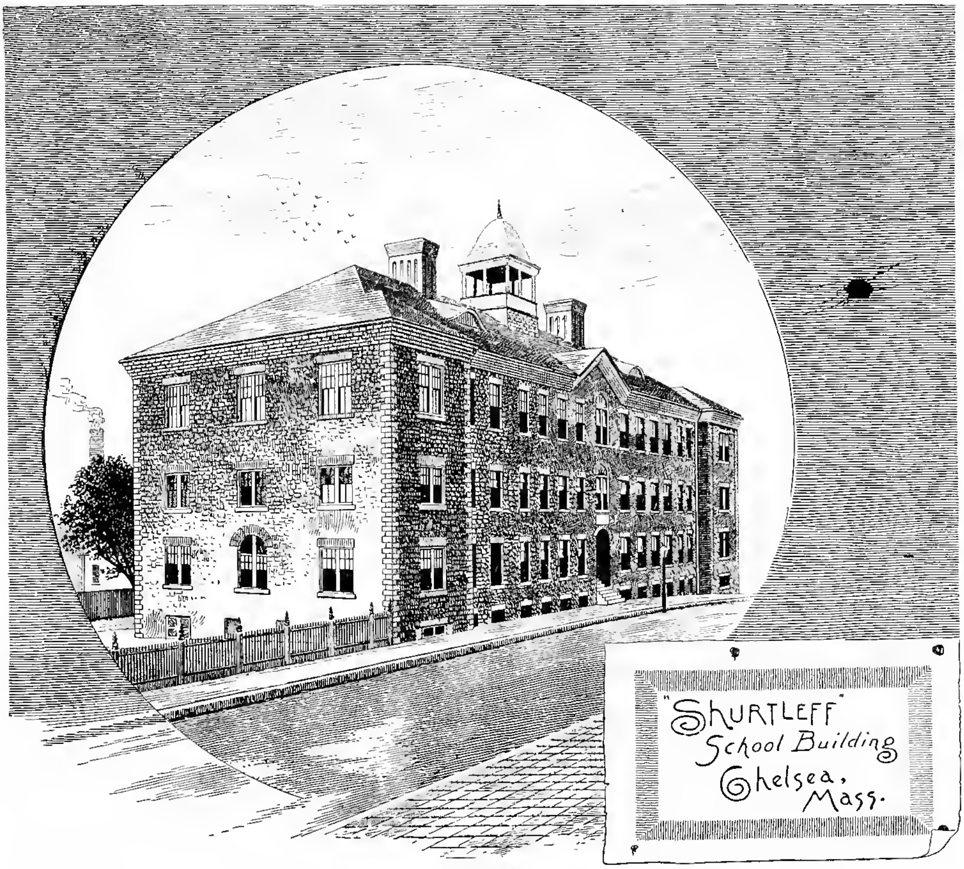
Twenty-six school buildings in Toledo warmed and ventilated by the Smead system.



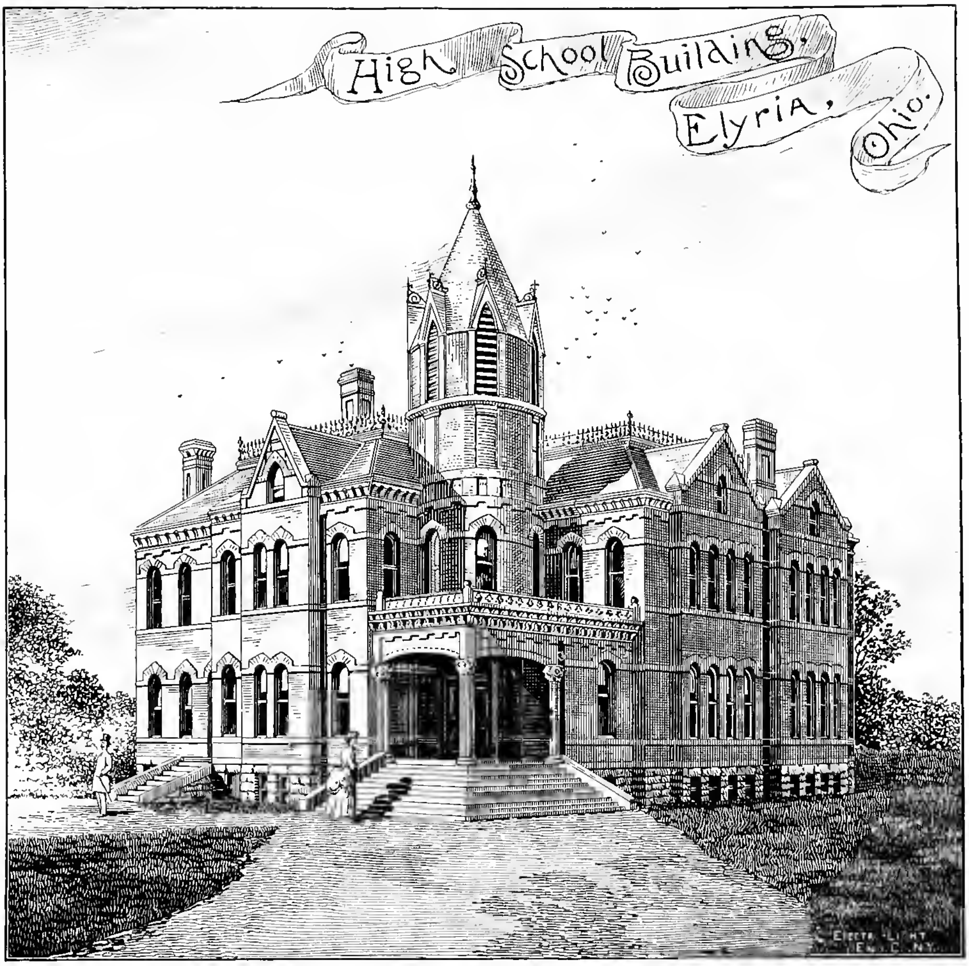
PUBLIC SCHOOL BUILDING, CAREY, OHIO.

F. K. HEWITT, ARCHITECT, TIFFIN, OHIO.

Warmed and ventilated by the Smead system.

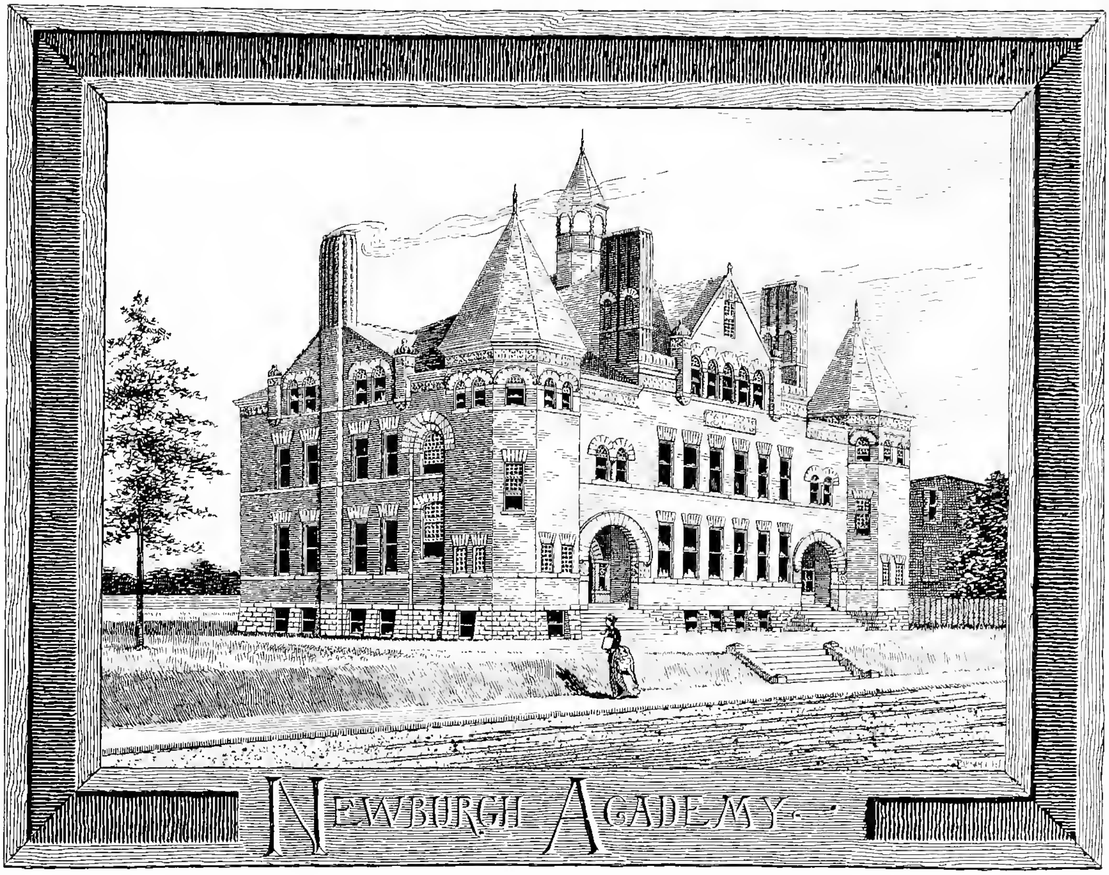


Warmed and ventilated by the Smead system.



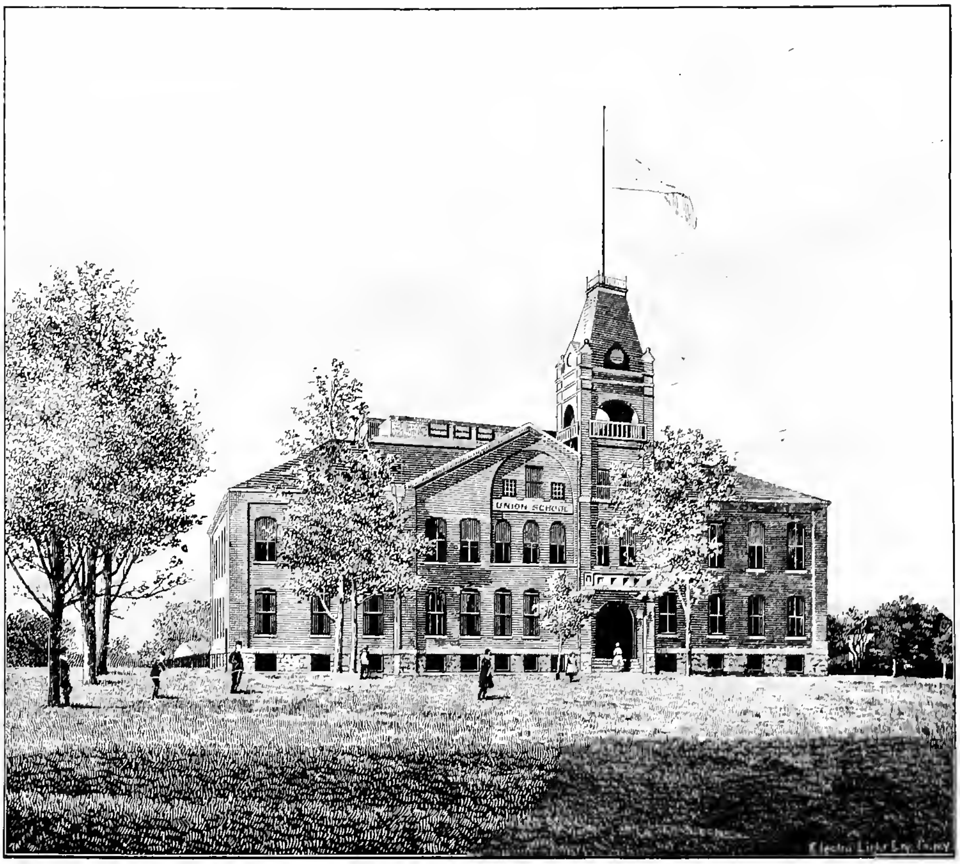
ELAH TERRELL & CO., ARCHITECTS, COLUMBUS, OHIO.

Warmed and ventilated by the Smead system.



Warmed and ventilated by the Smead system.

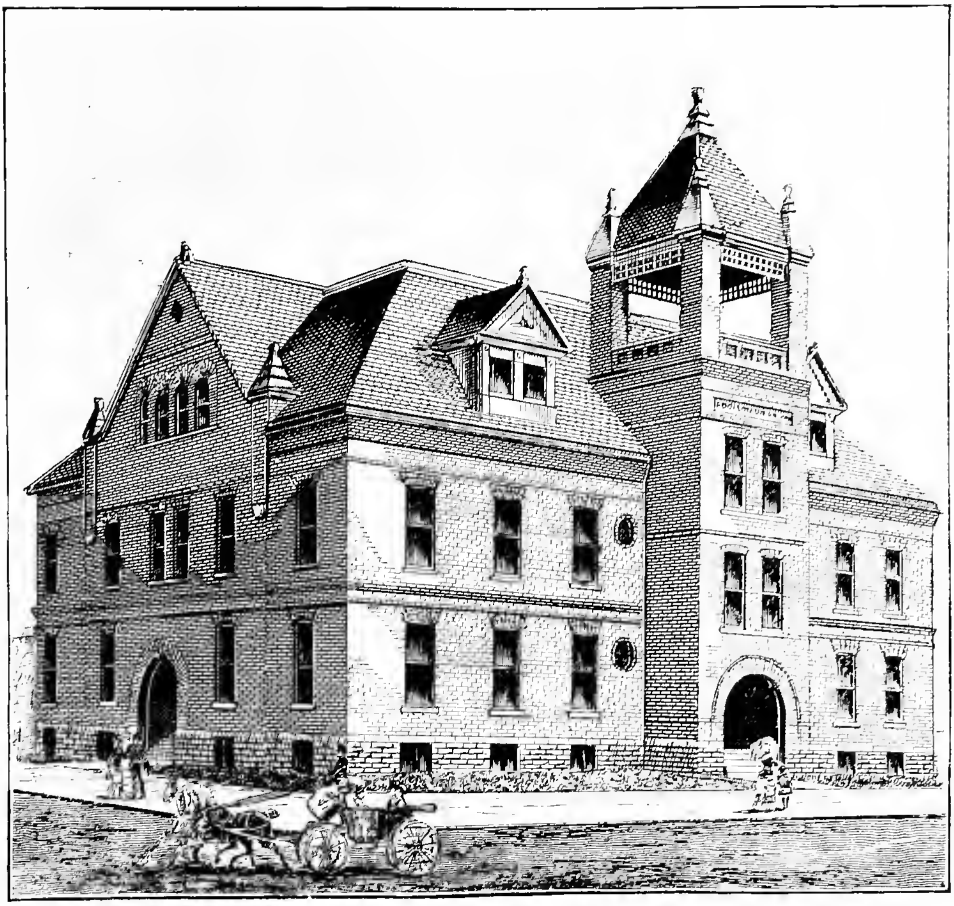
ROSSITER & WRIGHT, ARCHITECTS, 47 LIBERTY STREET, NEW YORK CITY.



UNION FREE SCHOOL, DANSVILLE, N. Y.

L. P. RODGERS, ARCHITECT, ROCHESTER, N. Y.

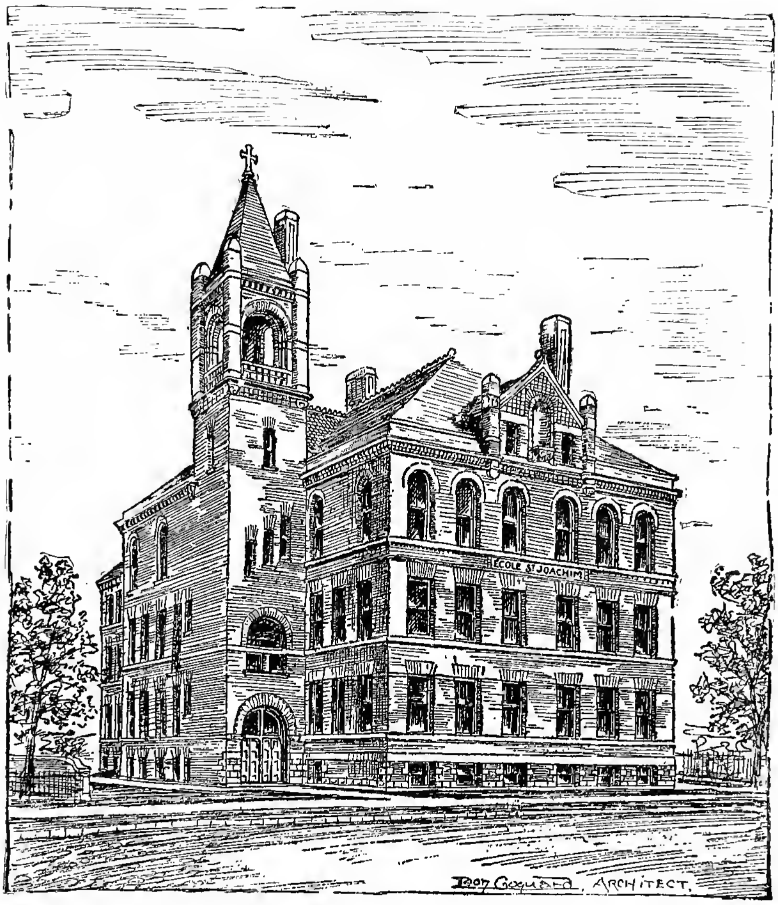
Warmed and ventilated by the Smead system.



ADDISON (N. Y.) UNION SCHOOL.

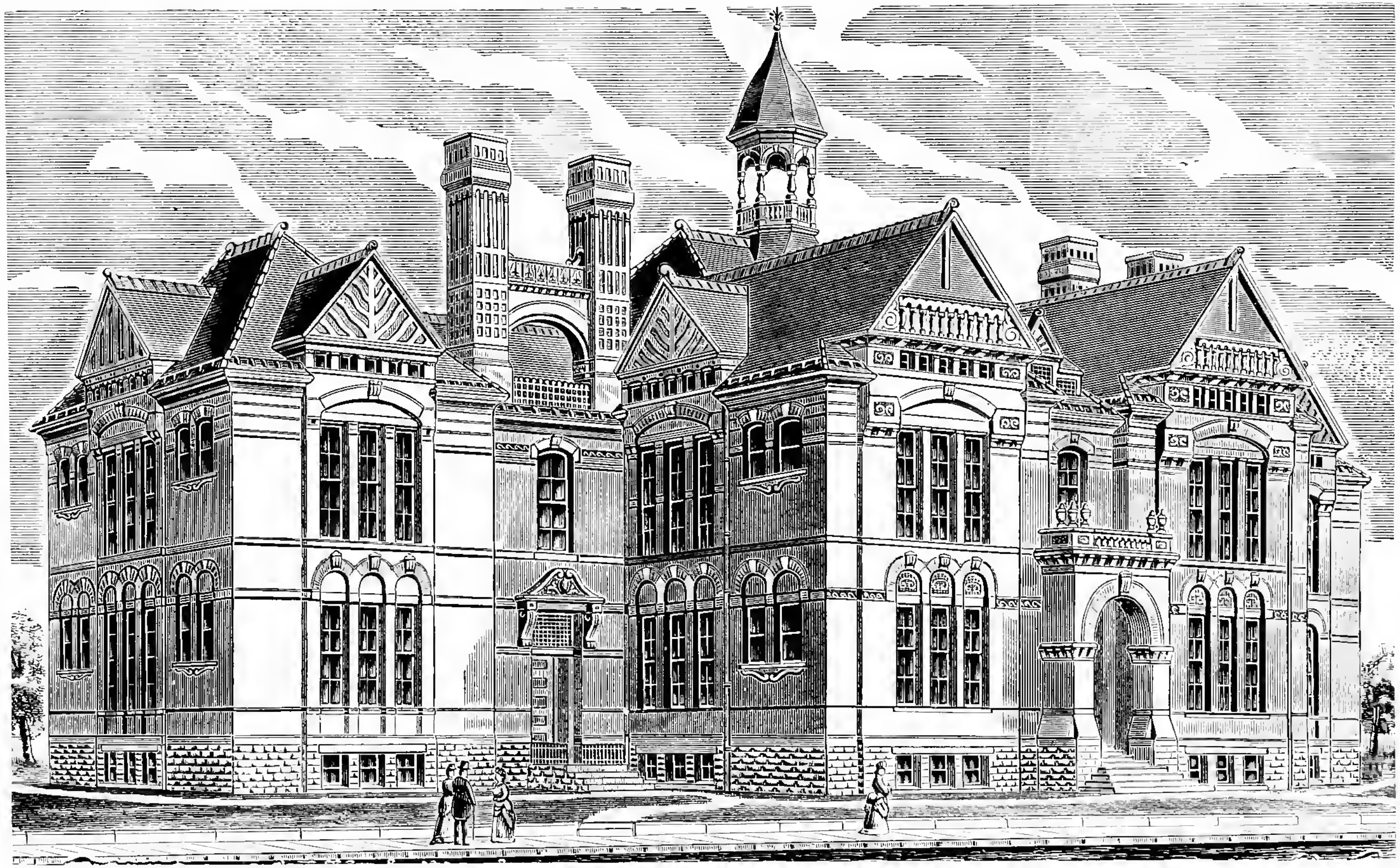
WALKER & NOLAN, ARCHITECTS, ROCHESTER, N. Y.

Warmed and ventilated by the Smead system.



ST. JOACHIM BUILDING, DETROIT, MICH.

Fourteen school buildings in Detroit warmed and ventilated by the Smead system.

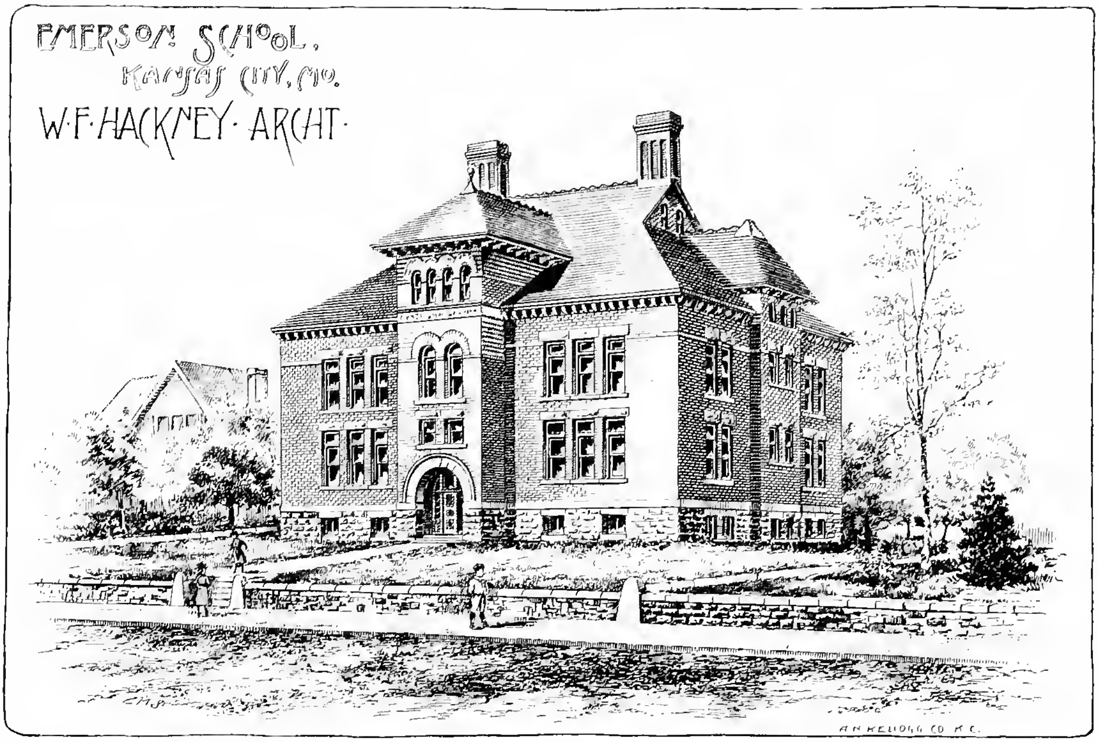


WARREN STREET SCHOOL BUILDING, TOLEDO, OHIO.

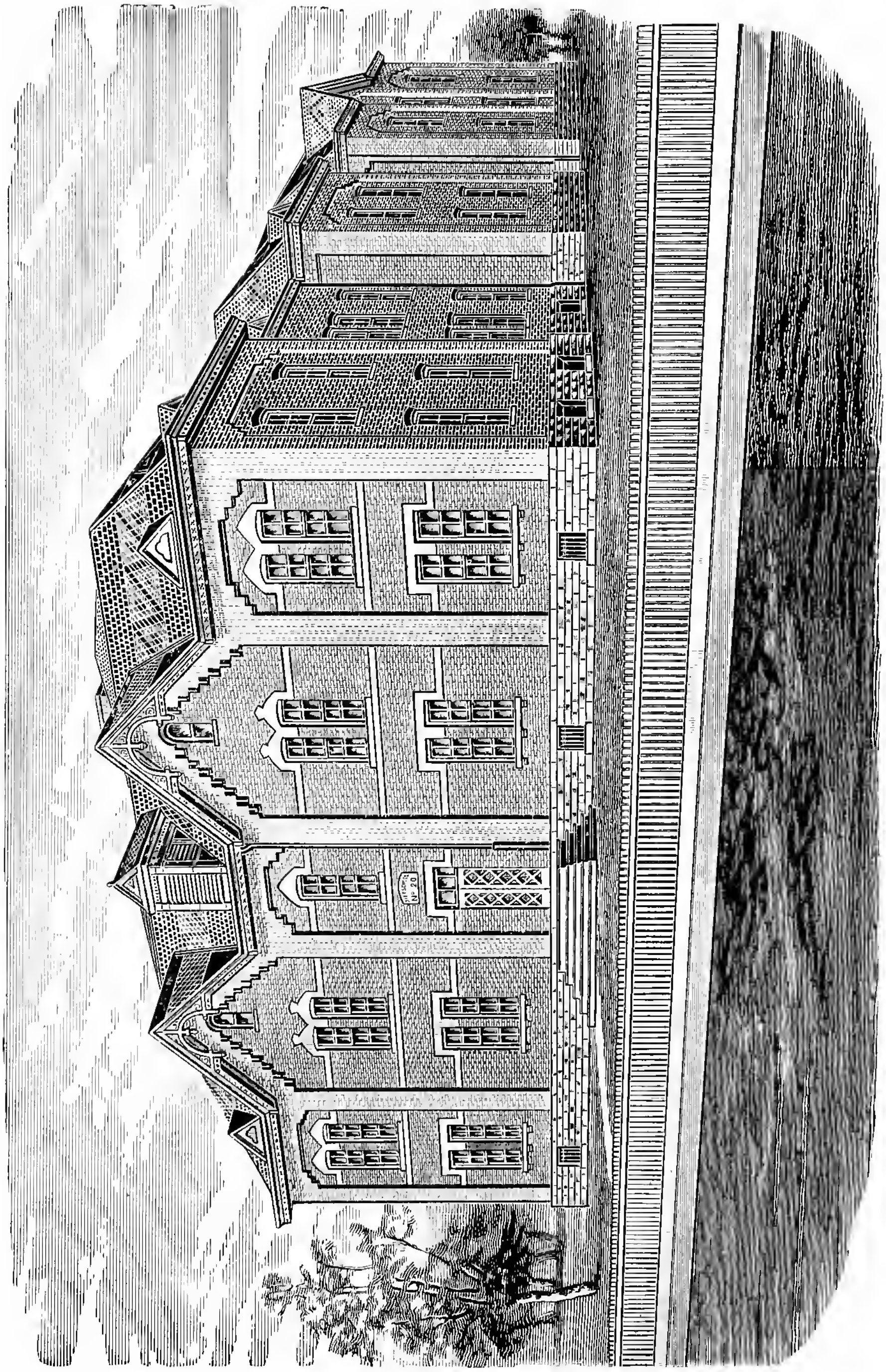
Twenty-six school buildings in Toledo now warmed and ventilated by the Smead system.

(Above building was formerly heated by "Hot-Air Furnaces.")

Nine school buildings in Saginaw warmed and ventilated by the Smead system.

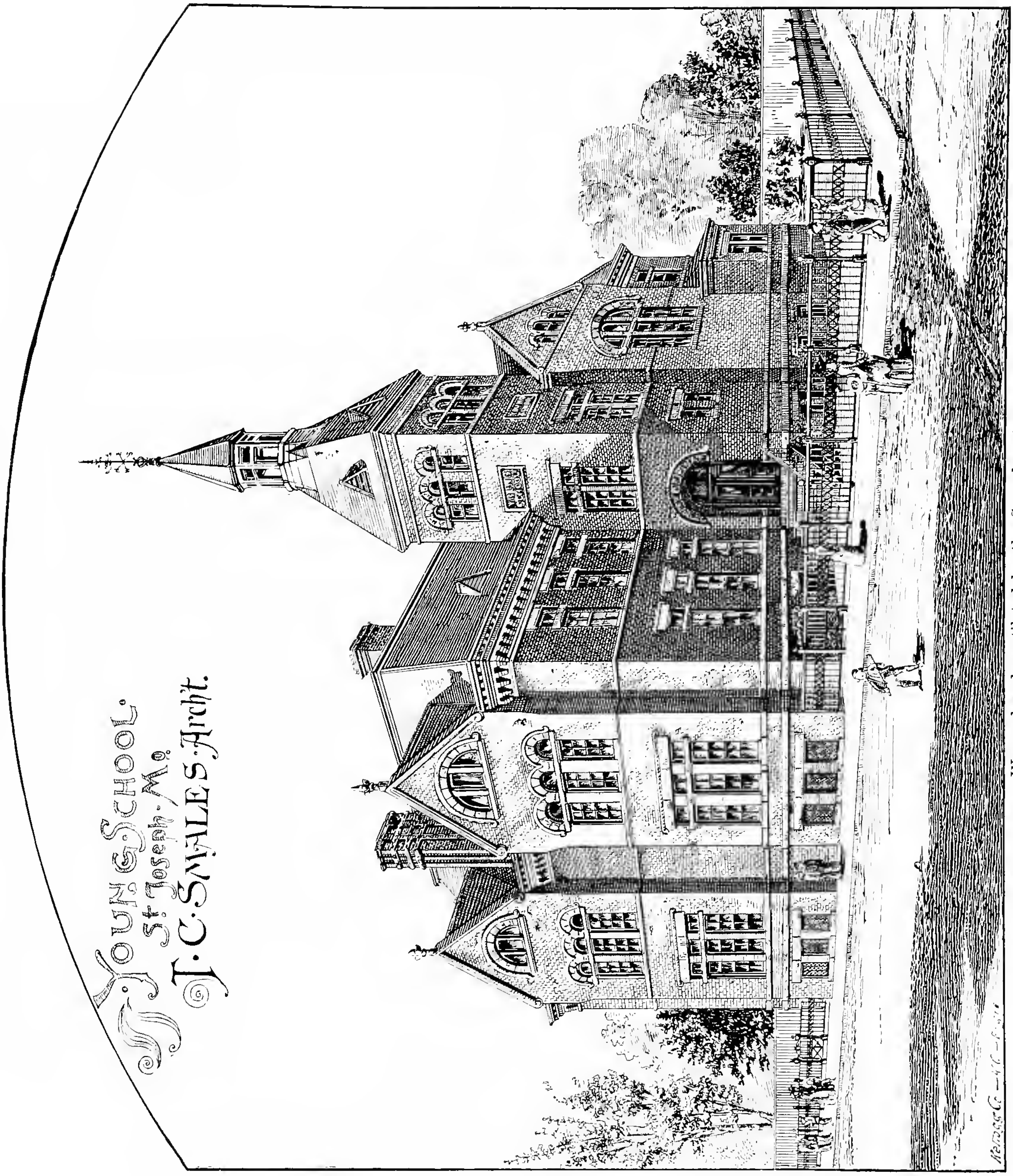

EMERSON SCHOOL,
KANSAS CITY, MO.
W·F·HACKNEY· ARCHT·
A N KELLOGG CO. K C.

Warmed and ventilated by the Smead system.

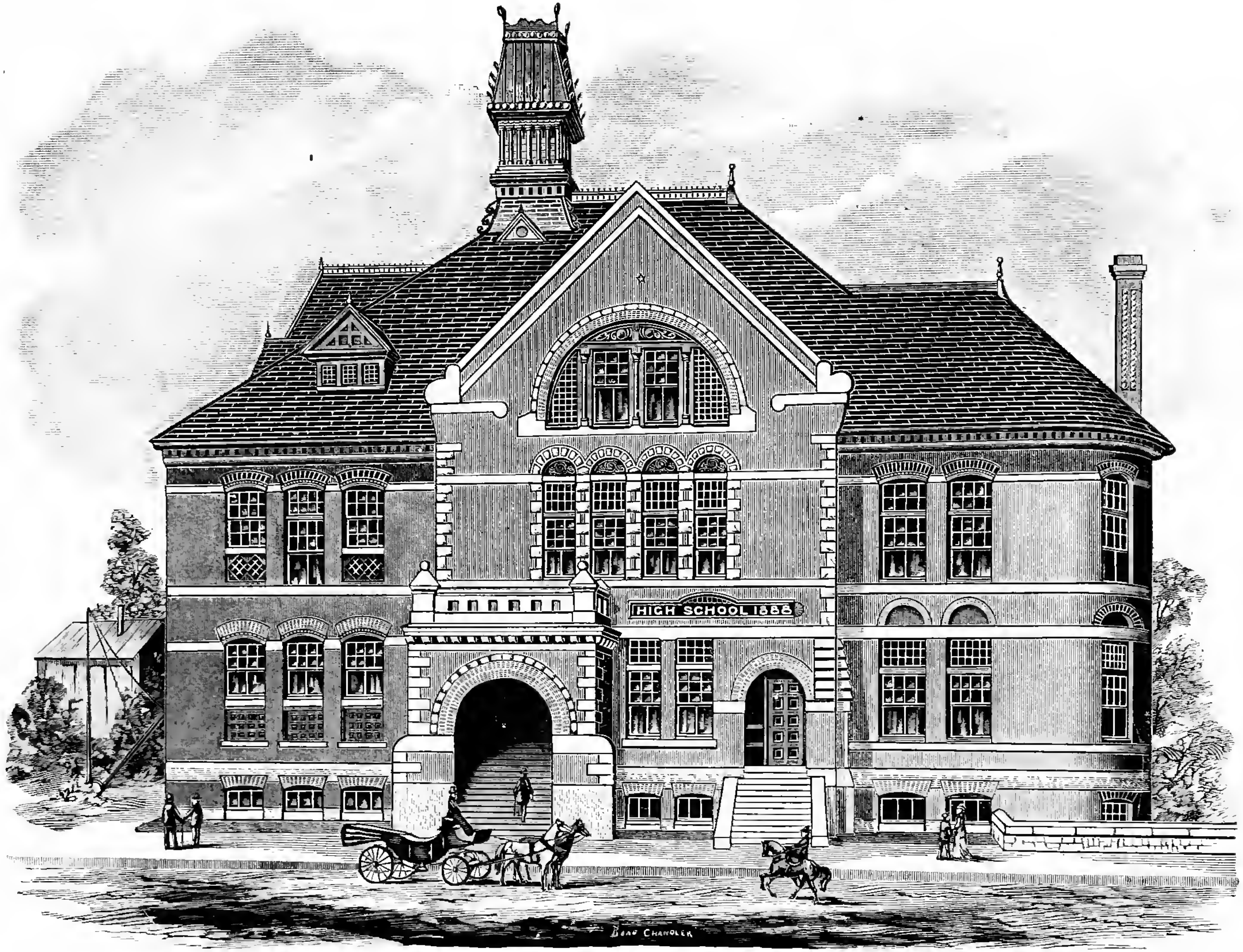


No. 20 SCHOOL BUILDING, ROCHESTER, N. Y.

Warmed and ventilated by the Smead system.


Young School
St. Joseph, Mo.
J. C. Smales, Arch't.

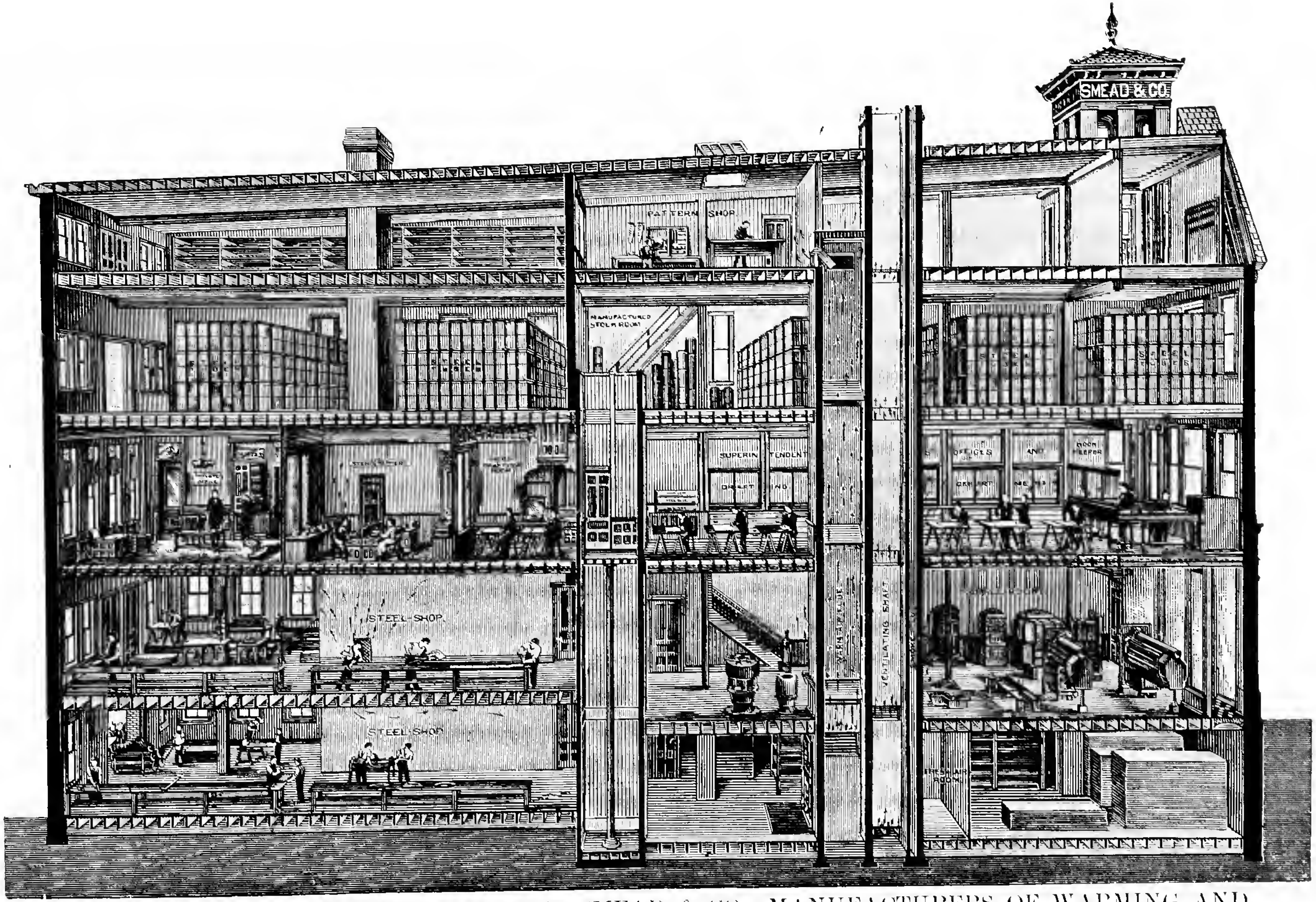
Warmed and ventilated by the Smead system.



HIGH SCHOOL, GLOUCESTER, MASS.

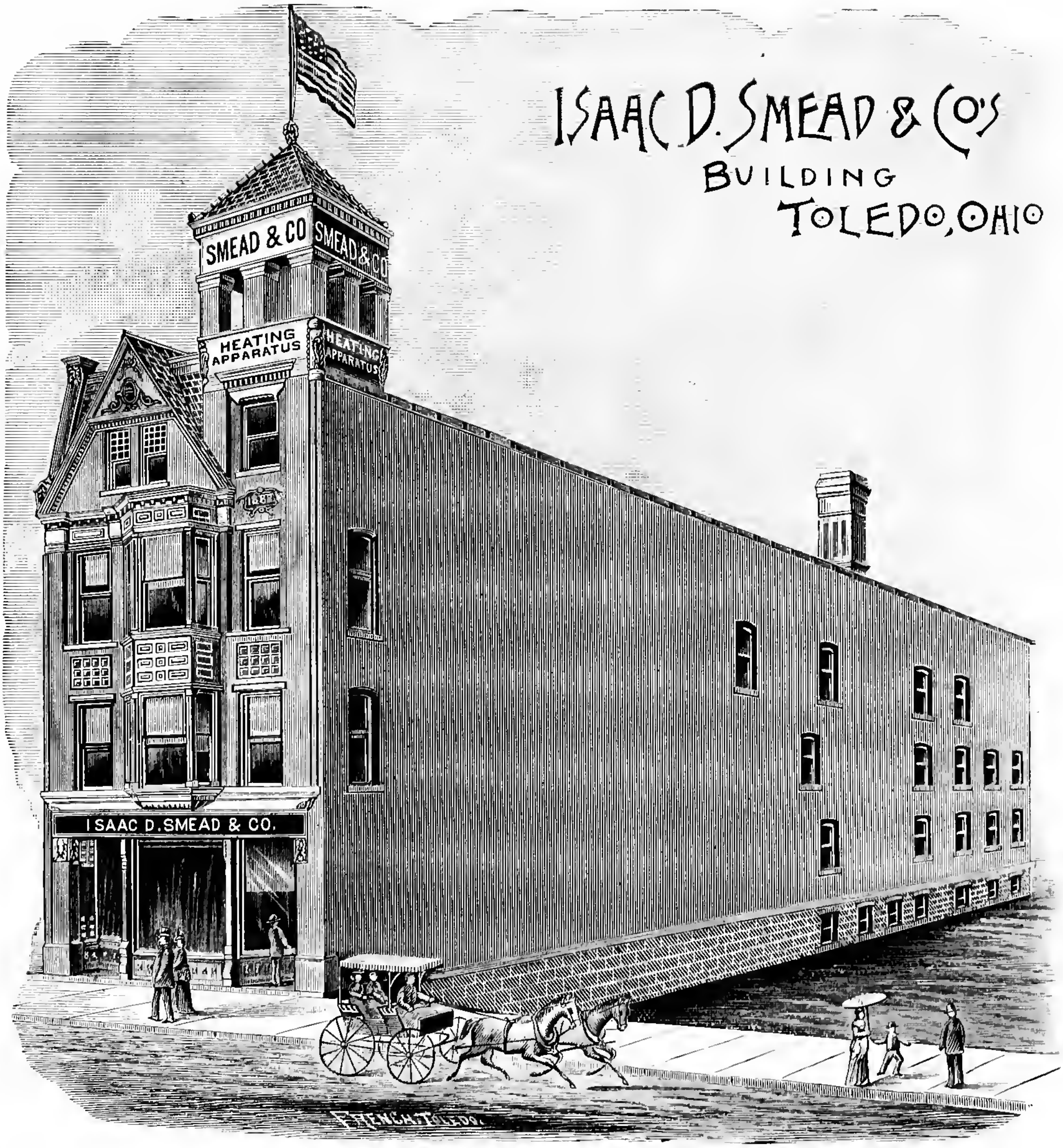
TRISTRAM GRIFFIN, 172 WASHINGTON ST., BOSTON, MASS., ARCHITECT.

Warmed and ventilated by the Smead system, with Smead system of dry closets.

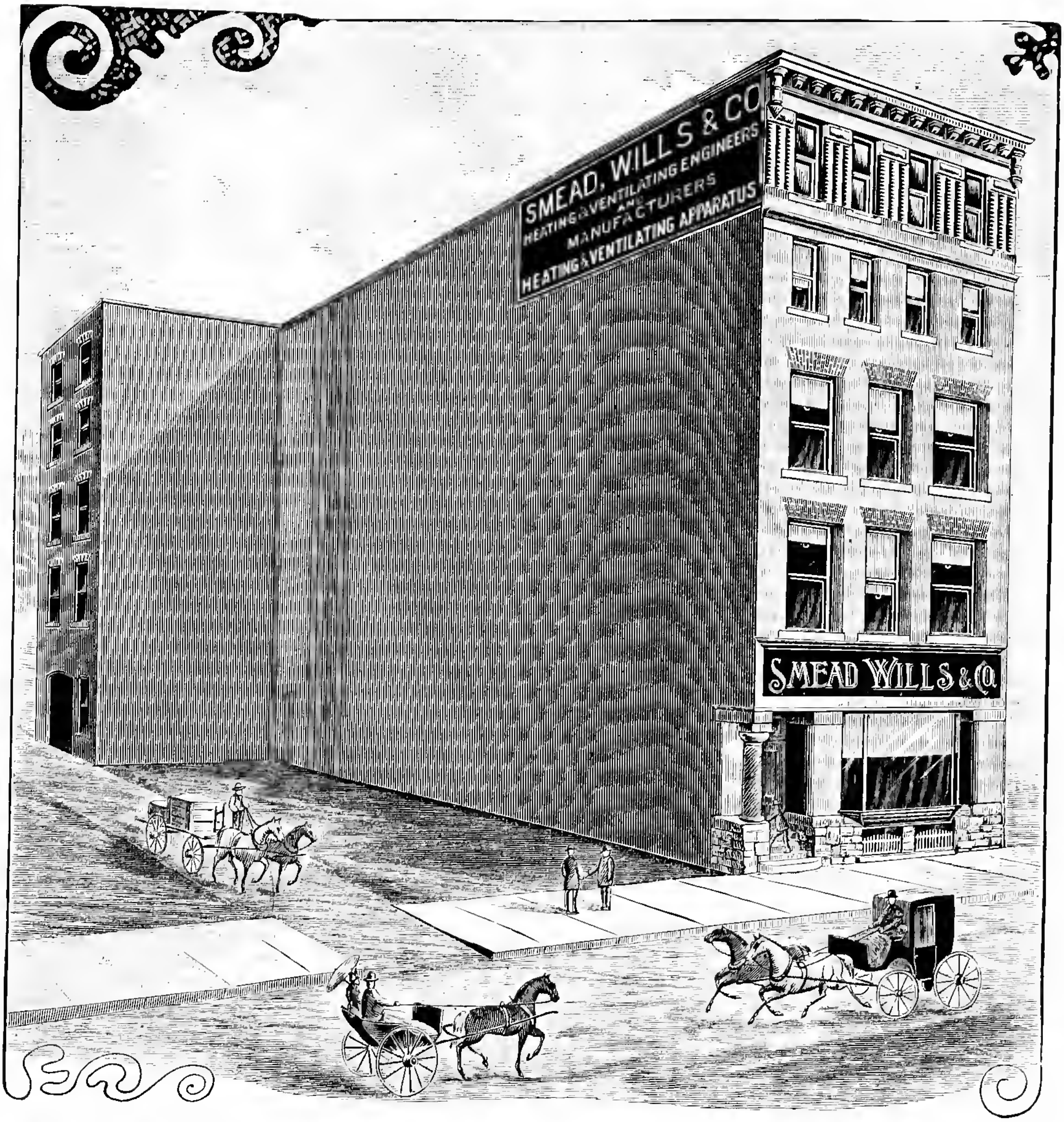


OFFICES AND WAREROOMS OF ISAAC D. SMEAD & CO., MANUFACTURERS OF WARMING AND VENTILATING APPARATUS, TOLEDO, OHIO.

Warmed and ventilated by the Smead system.

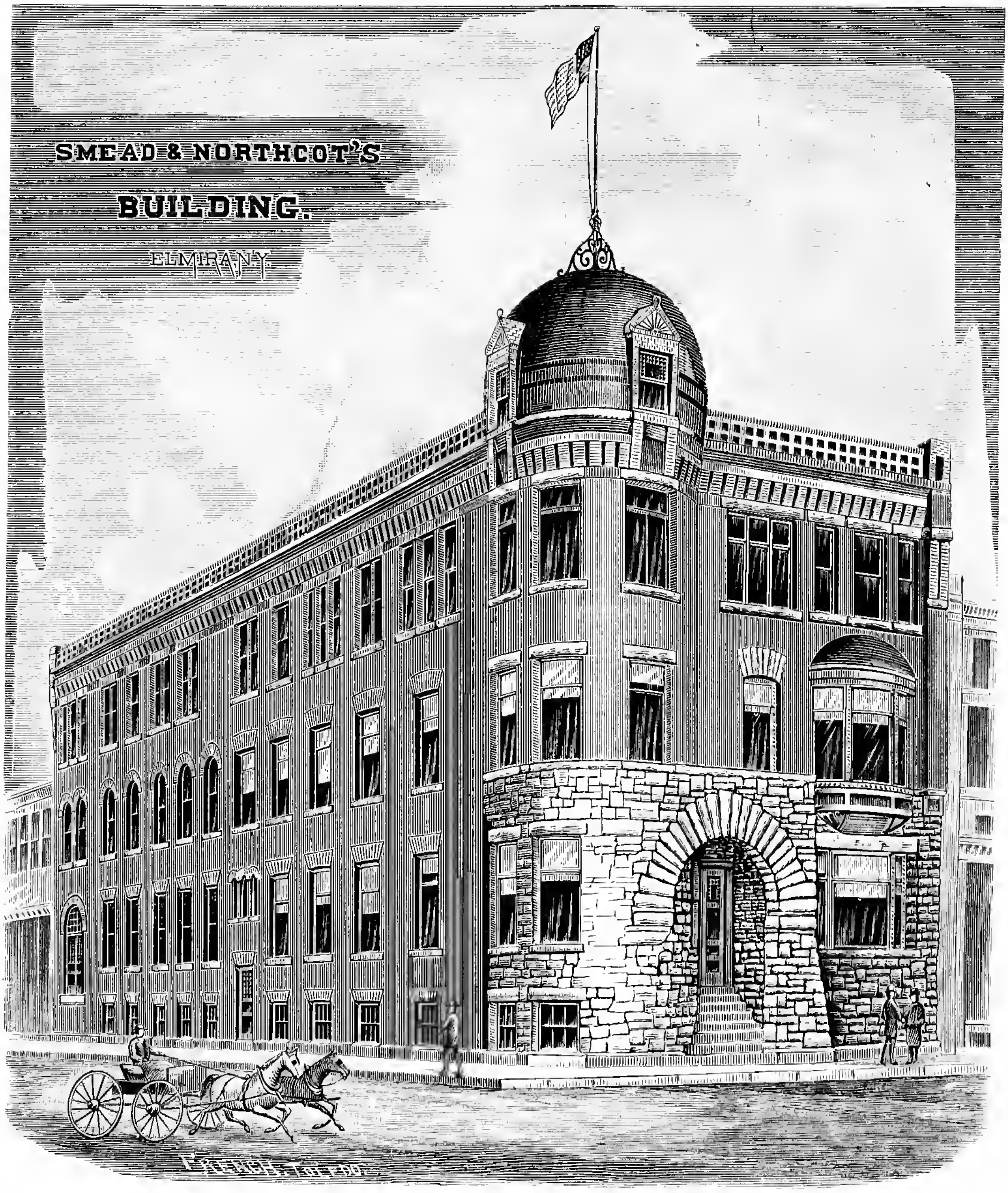


Warmed and ventilated by the Smead system.


SMEAD, WILLS & CO
HEATING & VENTILATING ENGINEERS
AND
MANUFACTURERS
HEATING & VENTILATING APPARATUS
SMEAD WILLS & CO.

SMEAD, WILLS & CO'S BUILDING, 417 LOCUST ST., PHILADELPHIA, PA.

Warmed and ventilated by the Smead system.


SMEAD & NORTHCOT'S
BUILDING.
ELMIRA, N.Y.
FRENCH. TOLEDO.

Warmed and ventilated by the Smead system.